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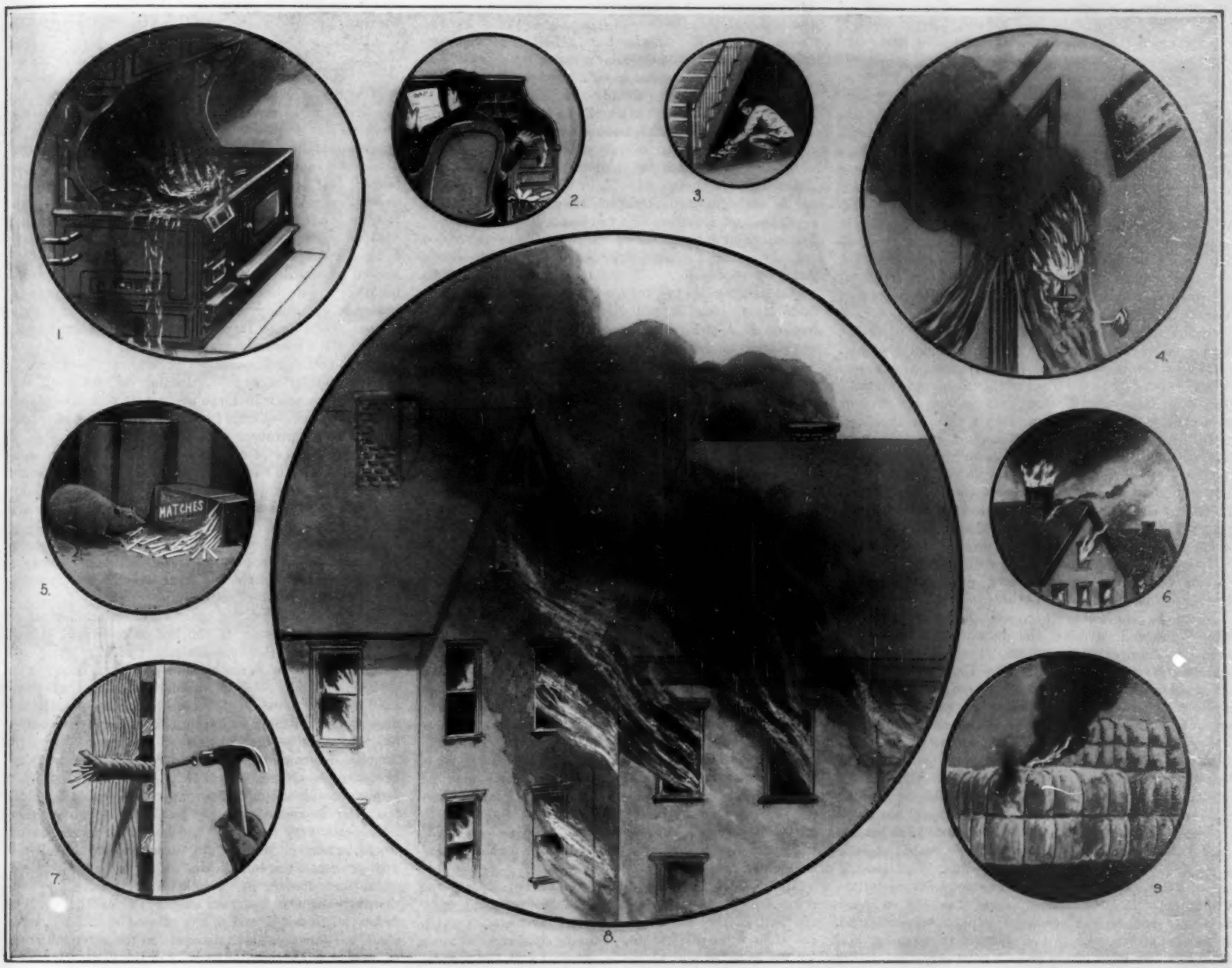

Some of our major fire-loss causes, as shown by figures for New York State

1. Miscellaneous causes, 6.8 per cent of all fires.—2. Smokers' carelessness, 4 per cent.—3. Incendiarism, 3 per cent.—4. Heating and lighting appliances, 7.3 per cent.—5. Matches, 4.3 per cent.—6. Defective chimneys and flues, 4.1 per cent.—7. Electricity, 4.7 per cent.—8. Exposure, 14.3 per cent.—9. Sparks and spontaneous combustion, 5.1 per cent. The circles are proportional, in size, to these figures. In addition there is the item of 46.5 per cent due to unknown causes which would be represented by a circle of diameter two inches greater than the length of this page.

How We Burn Up Our Property

ANALYSIS of a year's fires in New York State brings out figures rather uncomplimentary to the owners of the damaged property. Out of a total loss of some $20,000,000 no less than 21.7 per cent is found to fall under causes wholly preventable and 31.9 to have been in part at least avoidable, while 46.5 per cent is attributed to unknown causes. Among the strictly preventable causes we find all manner of faults which may be classified as bad construction, bad installation and bad practice. Defective chimneys, improperly exposed steam pipes, hot ashes or coals, are merely a few of many examples which might be given of the items which constitute the cause of an annual loss of $4,358,618.

Closer analysis of the partly preventable and the unknown causes increases this charge against our carelessness. Of the former, it is estimated that at least half of the fires caused by electricity, by sparks from fires or machinery, by spontaneous combustion and by explosion are preventable. These items total $2,262,268, and constitute 11.4 per cent of the total. Fires costing $593,107, or 3 per cent of the total, were traced to incendiaries; and while this can hardly be charged to carelessness in the same manner as can other items, it is certainly preventable in its entirety. Even if we then allow lightning and miscellaneous causes known but not classified, with losses of $654,042 or 3.2 per cent of the total, to go entirely under the heading of non-preventable—surely a liberal concession—we will have added to our preventable causes a loss of $1,724,241, or 8.6 per cent of the total. We have altogether then 30.3 per cent of the fire loss known to be preventable and 8.9 per cent conceded to be non-preventable. There is in addition an item of 14.3 per cent attributed to exposure from other fires, and then the 46.5 per cent of loss from unknown causes.

Now it is certain that the exposure charge is complete in itself. If a fire breaks out upon Mr. X's premises, it may consume all evidence of its origin; but if it spreads to Mr. X's property from that of Mr. Y, across the street or next door, this fact is bound to be known. Hence, the item "unknown causes" contains no losses due to exposure; and if we are to make any assumption about it, this can only be that it must be distributed between preventable and non-preventable in the same ratio as the fires of known primary causes.

This brings us to the "exposure" item: One of the problems confronting the insurance experts who worked out the figures which we quote was whether loss from exposure should be charged against the same cause as the fire from which the damage spread, or kept as a separate caption. The celebrated case of Mrs. Murphy's cow and the Chicago conflagration was cited as evidence; it would surely have been unfair to charge the unfortunate bovine with the universal destruction for which poor construction and inadequate protection were really responsible. Besides, if kept under a separate heading this item is subject to statistical control at any moment; while if bulked into the various other entries it would be instantly lost for good. So every fire which caught from another fire is charged to the item "exposure," regardless of the cause of the generating fire. At the very best, it is plain that 77.3 per cent of this loss is preventable—by the other fellow. But the insurance companies tell us that by proper safeguards such loss can be made practically out of the question—in other words, that it is wholly preventable, by the prospective loser.

(*Concluded on page 603*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

War and Business

A DISTINCTIVE feature of a democracy—we are not altogether sure whether it is an advantage or a drawback, and so refrain from calling it either—is that, in an emergency of any sort, there is always a prodigious number of volunteers eager to tell us in clarion tones just what to do about it. Unfortunately, these self-constituted prophets are usually in hopeless disagreement as to the proper method for leading the nation out of the wilderness; but this does not necessarily imply that their well-meant efforts represent a total loss of energy. It is entirely possible to accept the good which can be found in each proposition and, rejecting the bad and the extremes, to consolidate the various elements of widsom into a rational program.

This we are slowly doing in the present emergency. We have listened to the pleas of the "business as usual" extremists, who would refuse to recognize, by word or deed, that war exists, who would, in some unexplained mysterious way, raise industrial and military armies of millions without taking any man from his present work. We have given respectful audience to the violent pessimist who would make it almost a capital offense for an individual to indulge in any other act than eating, sleeping, making munitions and worrying. And we have with us, as always, many more or less contemptible wretches who would more or less deliberately apply the former philosophy to their own particular lines of business while subjecting all others to the latter.

As rapidly as possible we are assimilating these diverse viewpoints and striking the happy medium. That such a medium exists is obvious. Few, indeed, are the activities so totally frivolous that they deserve utter suppression. Few, indeed, are the industries or businesses or vocations which can be so suppressed with net gain to the nation. On the other hand, aside from the making of staple foods and munitions, there is hardly an industry which cannot properly and profitably be called upon to make certain downward revisions.

Nowhere, perhaps, is the business of adjustment to the correct wartime basis being more promptly or more intelligently carried out than in the case of the railroads. It is vital that all roads rearrange their schedules with a view to conserving fuel supply and to increasing capacity for moving coal, food, government materials and troops. It is obvious, however, that the ordinary passenger and freight schedules cannot be suspended indiscriminately; even in the midst of the greatest war of all time, we must travel and we must ship.

It is possible, however, to consolidate many passenger trains, running one in place of two or three or even more; and this possibility applies to single roads and between several roads. It is convenient for a commuter to know that trains run 15 minutes apart, but this frequent service is not necessary; it is pleasing to the New Yorker to know that he has a choice between some fifty trains for his Chicago trip, but he could do as well with less, especially when several of them leave at almost the same instant over different lines. Dining cars are pleasant places; but it is absurd to suppose that a man cannot so adjust his affairs and his appetite that he will survive the trip from New York to Boston or Washington, from Chicago to St. Louis, without refreshment *en route*—and for every diner eliminated, a coach carrying 80 passengers can be added. Nor is it necessary to run half a dozen sleepers on a single train, each half filled, simply in order that passengers may reach a wide variety of destinations without getting up at 4 A. M. By the same token the traveling public may well be asked to ride more in 80-passenger coaches and less in 30-passenger parlor cars; the latter are luxurious, but far from essential.

These and similar economies reduce the equipment and personnel which the roads must devote to certain branches of service, without cutting down the value of that service to the users. One road expects to save 6,000 car miles per day upon the eastern half of its system by such measures. And the business man in all fields may take his cue from the action of the carriers. He may ask himself in what directions he can cut down his consumption of labor, material or transportation, without serious prejudice to his customers. By putting the question of wartime adjustment in this light and answering it intelligently, he can at once accomplish the most good and the least harm.

Coöperation of Motor Truck Manufacturers for the Good of the Nation

THIS war is accomplishing wonders that were considered beyond the realm of possibility a few years ago. The spirit of coöperation that is being manifested in every direction is remarkable, and is filling the entire land with the fervor of patriotism.

A magnificent example of coöperation is furnished by the Society of Automotive Engineers in conjunction with the Advisory Commission of the Council of National Defense, when, at a recent meeting, the decision was reached that the engines and transmissions to be used in the majority of the military trucks shall be interchangeable regardless of the particular make of the truck. The importance of this decision can scarcely be overestimated. America has already made a specialty of standardization, and when an article has become standardized we have been able to outstrip foreign competitors in quantity and quality of output.

In the production of motor commercial vehicles America leads the world. Naturally our allies expect us to make a very large contribution to the motor equipment of the men who are fighting the invader in France. Our manufacturers are now bidding on 70,000 military trucks for our army, and when the American Army appears in Europe it will undoubtedly be the best motored army in the field. We are planning to use motor transportation, not only for supplies but also for hauling field guns. We have actually built the first completely motorized artillery battery.

The advantage of motor transportation over the horse-drawn type is to be found not only in the field but chiefly in the repair shop. When the horse is slightly injured it takes a long time to perfect repairs, for Nature is a slow mechanic; and if a horse is badly injured it must be scrapped forthwith. The motor vehicle, on the other hand, when tended by skilled and resourceful mechanics such as have been developed in large numbers in this country, may soon be put in shape for further use, even when seriously disabled. The part that the repair shop plays in war is much greater than that in the walks of peace, because not only must the truck contend with natural difficulties, but it must be strained to the limit to carry supplies and is exposed to the cunningly devised hazards prepared by the enemy. It is of the highest importance, therefore, that every facility be provided for making quick repairs. If motor trucks of a dozen different types are in use and each requires its own special spare parts and also a mechanic skilled in handling its own particular mechanical peculiarities, the time consumed in making repairs will undoubtedly be greatly increased. By having standardized parts which are interchangeable, no matter what the make of truck, the stock of spare parts may be reduced and the time consumed in replacing an injured member may be materially cut down. A smaller force of mechanics will be required for emergency repair work and the efficiency of the repair department will be greatly increased.

The decision to standardize the motor truck parts was not reached without a great deal of compromising upon the part of the various commercial interests involved, and their willingness to give up individual consideration for the good of the nation is deserving of the highest commendation. The benefits of this willing compromise are sure to be felt in the commercial as well as the military use of the motor vehicles and the manufacturers of standardized trucks will undoubtedly receive a just reward.

Pressing Problems of Science Still Unsolved

WE had occasion to announce a few weeks ago the creation of an Industrial Research Laboratory under the auspices of the French Academy of Sciences. In a notable address before that body, M. Henry le Chatelier, professor at the Sorbonne and at the School of Mines, has called attention to certain problems that press for a speedy solution, and has set forth the principles which must guide collaboration between scientists and industrialists. He particularly voiced the warning that if either encroach too far upon the proper domain of the other the result will be a needless and disheartening waste of both money and time.

A striking example of failure to apply this principle is offered in the attempts of the great French glass-works to discover the secrets involved in the manufacture of chemical glassware, of which, three years ago, Germany was the great purveyor to all the world. Here the empirical gropings of the industrialists are sorely in need of scientific guidance. Each fusion of a new trial mixture, made in the ordinary crucible of the works, costs about a hundred dollars, which is a dead loss if the glass is unsatisfactory. But a man of science devoting himself to the study of this question makes his tests with a few grams of material melted in the laboratory in a platinum crucible, instead of requiring three or four hundred kilograms. Moreover his first and most important tests would be directed to the determination of general laws. Since the principal quality demanded is a wide scale of fusibility, a first step should be to measure the variation of the coefficient of viscosity with relation to temperature and chemical composition. Thus the number of industrial castings would at once be definitely limited. In the same way the laws of dilatation which play so important a part in ceramics can be determined, as well as the degree of electric resistance, where the manufacturer of insulators is concerned, or of chemical inalterability where it is a question of instruments for analytical use. As M. le Chatelier observes, such labors are truly the province of the scientist, for though the task is tedious the results when once determined, can be utilized for centuries.

Under the head of metallurgy, the lecturer pointed out that in the manufacture of projectiles for naval warfare it is highly important to possess a means of measuring the degree of hardness of tempered steel. The present methods are unsatisfactory, the least faulty being by the sclerometer of Shore, which makes use of the rebound of a small steel projectile terminating in a diamond point. But the results are not conclusive, since they depend upon a combination of factors, notably upon the form of the pieces shocked. Here is a highly interesting field of study, that of the laws of rebound of elastic bodies, a subject in which we are but little more advanced in knowledge than Leonardo da Vinci. A combination of calculation and critical experiment ought to enable us eventually to define conditions in which other factors would be so far eliminated that rebound would depend almost entirely upon superficial hardness.

The increasing importance of high temperatures in various industries draws attention to the fact that existing pyrometers lack the precision which is desirable. Thus, the thermo-electric force of a couple depends above all on the temperature of the joint, but also, in a less degree on the law of distribution of temperatures along the wires between the elements. This is a phenomenon known as yet only qualitatively, but of which it is highly desirable to attain a quantitative knowledge. Again, a homogeneous wire, heated in the middle under such conditions that the temperature variation shall be different in different parts of the heated zone, gives rise to a parasitic thermoelectric force which varies in intensity with the nature of the metal.

The indications of the optical pyrometer depend on the power of emission of the bodies observed. Up to the present time the emissive power of only three substances has been investigated—platinum, iron oxide, and nickel oxide. Many familiar substances, therefore need to be studied in this respect. Finally, measurements made with the radiation pyrometer are influenced by the variable distribution of temperatures in the metallic container of the apparatus. This influence needs to be studied in order to define the conditions required to annul such disturbance. It should be added that the Siemens-Callendar platinum resistance thermometer is very exact, but too fragile for usage in ironworks, while the normal gas thermometer, though also very precise, is too complicated except for laboratory use.

Another domain of investigation concerns the conductivity of the materials employed for the walls of industrial furnaces, and of the masses of coal burned in them. These are essential factors in the economical use of fuels. While the conductivity of the various metals is well-known, only empirical information as to that of refractory materials is at our service, and this varies, moreover, from a hundred to two hundred per cent, according to the conditions of manufacture. Indeed, not even empirical information is at hand as to the conductivity of masses of coal, though this is the main factor in the fusion or non-fusion of puddler's slag.

The lecturer closed these stimulating suggestions by a few remarks on the application of scientific study to agriculture. Here, M. le Chatelier declares empiricism has had almost entire sway, even at agronomic stations. Yet such scientific researches as those of Boussingault and Schloesing are of the broadest value. A question which clamors for solution to-day is that of the laws governing the germination of seeds. Here the principal factors are humidity, temperature, and oxygen supply. "There are not to-day," he says, "half a dozen seeds which have been methodically studied in this regard; yet such a study should be made of thousands. This would permit the choice of plants suitable for a given climate with far more certitude than at present."

These are but specific examples that might be multiplied in every realm of industry. The cardinal endeavor should be first, the effort to encourage the chemist, the physicist and the biologist by rewards sufficient to stimulate prolonged and patient research, and, second, the inducement of industrial leaders to seek the advice that only the trained scientist can give.

Naval and Military Notes

The Question of Navy Ammunition.—The prospects of the Navy being able to secure a sufficiency of ammunition are decidedly encouraging. The advertisements of the Government for bids on target shells and common projectiles revealed the fact that thirty-four ammunition makers were ready to take orders for shells on a scale which proves the enormous capacity of American plants. Fourteen firms offered to take the entire order for 1,170,000 one-pounder shells, the total bids on this size being for nearly 20,000,000. One plant offered to turn out from 3,000 to 5,000 shell cases per day. There were seven bids for 3-inch projectiles at the rate of 10,000 a month. For the entire order for 3,000 14-inch shells there was six separate proposals covering the entire order. Other bids showed that the plants have a capacity of 30,000 6-inch; 2,500 14-inch and 2,500 12-inch shells per month within thirty days after contracts are signed.

Shell Expenditure on the Western Front.—The British Ministry of Munitions has stated that the British expenditure of shells of 6-inch caliber and upward during the first week of the offensive that opened on April 9th, was nearly twice that of the first week of the offensive on the Somme, while expenditure of such shells during the second week was six and a half times that of the second week on the Somme. The weight of projectiles fired from the German field guns of 77 millimeters, in the Battle of the Somme in July of last year, was more than 121,000 tons, according to figures given in the Field Artillery Journal of the United States Army. These figures were taken from the report of General Sixt von Arnim, which states that one field battery of howitzers expended in one day 3,500 gas shells. On the forty-mile battle front of the Somme the Germans had 3,500 guns and the total number of projectiles fired during the month is estimated at 15,732,500.

The Quick Helm and the Submarine.—The ship that is quick on her helm has a much better chance to evade a torpedo than the one which has a large turning radius. Warships have been designed with this fact in view—not only is the helm made of large area but the deadwood is cut away much more than it is in merchantships. It is quite possible to reduce the deadwood of a merchant ship considerably, particularly at the stern, without sacrificing any of the cargo carrying capacity. The wake of a torpedo can be seen at a considerable distance in a smooth sea, and there will be times when the difference between a short and long turning radius will mean the difference between being sent to the bottom and evading the torpedo altogether. During one of the fights at the mouth of the Elbe, off Heligoland, some sixty ships of the British and German fleets, all carrying torpedoes and using them freely, were engaged for about six hours' time without a single hit being recorded. All of these were fast ships capable of quick manuevering.

The Death of Louis Gathmann.—The death of Louis Gathmann at the age of 74, recalls to mind the indefatigable labors of this inventor in the development of the high-explosive shell which bore his name. It was Mr. Gathmann's belief that it was not necessary to carry the high explosive shell through armor plate and into the interior of a ship, but that if a sufficient quantity were detonated against the outside of a ship it would be equally, if not more, destructive. He secured from Congress an appropriation for an 18-inch gun capable of throwing a shell containing 500 pounds of guncotton. Our Army and Navy officers held that the only effective shell would be one of the armor-piercing type provided with a delayed-action fuse, which would burst the shell back of the armor. Both types were tested at Sandy Hook about eighteen years ago. The armor-piercing shell penetrated an 11-inch plate and tore the backing to pieces. The Gathmann shell burst against the face of the plate but failed to do more than dent it in the earlier rounds, finally cracking it in two in the last round. The superiority of the armor-piercing shell was thus established.

Interdependence of Western and Eastern Fronts.—Undoubtedly one of the explanations of the intense and unbroken continuity of the French and British attacks on the Western front is the desire of the Allies to prevent active German operations against Russia during the period of re-organization which must take place as the result of the recent revolution. That this policy is effective is shown by the rumored and probable transfer of several hundred thousand German troops from Russia to France. So terrific is the pressure exerted by the Allies that Germany is probably unwilling, and indeed, unable to find sufficient troops for major operations on both fronts at the same time. Any one who reads between the lines of the reports of the Western battles must realize that the losses on both sides are colossal, particularly those of the Germans in the many massed attacks they have made in the fruitless effort to retake positions that have been gained by the Allied troops. Incidentally, the fact that Germany has transferred such large forces from the Russian front proves that our worst fears as to the military dissolution of Russia are only too well founded.

Science

Studies on the Strength of Hollow Tiles have been undertaken at the Bureau of Standards in response to requests from tile manufacturers, and the data obtained will be placed at the disposal of the American Society for Testing Materials, a committee of which has been charged with the task of preparing specifications for hollow building tile. The Bureau is building a number of experimental walls, five feet long by twelve feet high, and of various thickness. About fifty of these walls will be built, embodying different styles of construction. The tests of the walls will include one in which a load will be applied across the middle of the side, in order to give some idea of the ability of the walls to withstand wind pressure.

The MacMillan Expedition.—As we go to press the Museum of Natural History announces the delayed receipt of a long cablegram from Donald MacMillan giving further particulars of the Crocker Land expedition, the safety of which we chronicled last week. This dispatch is of interest chiefly by reason of the details which it gives of the scientific results achieved by the expedition. The country now explored for the first time lies roughly between 77 and 79 degrees north and 90 and 105 degrees west. In passing over Ellesmere Land to reach this region from Etah a "wonderful game country" was traversed, abounding in wolf, caribou, musk-ox, seal, hare, ptarmigan, lemming, fox and polar bear; but west of 97 degrees this began to fail. Much coal was seen and the evidences noted of a recent coastal uplift along all shore lines. The botanical, geological, glaciological, ornithological, ethnological, archeological seismographic and meteorological work accomplished as a result of this trip is described as noteworthy. The role of the camera in modern exploration is again emphatically demonstrated. The party is reported in good health and spirits, with a supply of food sufficient to make the normal Caucasian diet possible until August. A busy summer is planned while awaiting the arrival of the relief ship which will be sent out at the earliest possible date.

Cosmophysical Observatories.—In last year's report of the Carnegie Institution, Dr. Bauer, director of the Department of Terrestrial Magnetism, explained the need of establishing new observatories for making continuous records of variations in the earth's magnetic and electrical condition. "The belief," he said, "is becoming current more and more that fluctuations in the earth's magnetism or in the earth's electricity not only contain in them secrets pertaining to physical changes going on within our own planet, but within the universe." Dr. Bauer proposes to call such institutions "cosmosphysical observatories," to distinguish them from astronomical, astrophysical and meteorological observatories. The world now possesses forty-nine magnetic observatories, of which thirty-nine are in the northern magnetic hemisphere. In view of the unsatisfactory distribution of these stations, Dr. Bauer's department has organized an "observatory division," for the purpose of planning and establishing at least two cosmophysical observatories in the southern hemisphere. From the current report of the Carnegie Institution we learn that one of these observatories is now in course of construction near Marchagee, about 150 miles north of Perth, Australia, and it is hoped to establish another one in Peru during the present year.

The Commission on Milk Standards appointed by the New York Milk Committee has been for the past six years conducting work of national importance, and is virtually a national body, despite its local origin and the fact that its expense is borne by the New York committee. The latter is a voluntary organization, working for the improvement of the milk supply of New York city and the reduction of infant mortality. In March, 1911, the committee invited 20 experts, in various parts of the country, to become members of a Commission on Milk Standards. The present membership includes eight public health officers, seven bacteriologists, three chemists and two agricultural experts. This commission has held eight meetings, some of them in New York and some elsewhere. Its third and latest report has recently been published by the U. S. Public Health Service. Besides defining three grades of milk (A, B and C), according to bacterial count and other qualities, the Commission has made recommendations dealing with nearly every phase of the dairy industry. It has, for example, proposed chemical standards for milk, with respect to its nutritive value, as distinguished from its public health aspects, to which grading applies. Thus standard milk is defined as containing not less than 8.5 per cent of solids-not-fat and not less than 3.25 per cent of milk fat. Standard skim milk should contain not less than 8.75 per cent of milk solids, while standard cream should contain not less than 18 per cent of milk fat, and be free from all constituents foreign to normal milk. Recommendations are made concerning pasteurization, tuberculin testing of dairy cows, butter, buttermilk, condensed milk, ice cream, etc.

Industrial Efficiency

Combination Glove and Shield.—There has been developed a novel shield for the protection of workers using a pneumatic chipping hammer, which consists of a wire screen riveted to and suspended from a glove. The fin to be chipped off lies between the shield and the chisel which drives the chips against the guard.

What to Wear and How.—The skin should be kept clean and warm and should have air. To keep the body healthy clothes should not be tight, declares the National Safety Council. In cold weather we should wear lightweight clothes while in the house. Upon going out of doors put on heavy outer clothing. Do not wear a tight hat. It cuts off the blood from the skin of the head and makes you bald. A soft hat is the best. Do not cripple your feet with tight shoes. Shoes that fit cost no more.

Increasing the Farmer's Production.—The Provincial Government of Ontario contemplates placing tractors at the disposal of farmers as a means of greater production. The government has about thirty-five district representatives in the more important agricultural counties of the Province, and apparently intends to place a tractor at the disposal of each of these representatives, to be used in assisting the farmer to plow and prepare his land for the planting of crops. It is proposed to make a nominal charge per day or per acre and to keep the tractors going day and night.

The Danger of Sleeves and Ties.—Although time and again workmen have been warned regarding the danger of loose clothing when working around machinery, it appears that many of them persist in ignoring the danger. As a result 986 workmen were killed in the United States last year by being drawn into the wheels of machinery or thrown to death when parts of their clothing became caught in rotating members. Loose sleeves and neckties are prolific sources of danger, and should not be tolerated for a single moment by the careful worker.

When Women Take Men's Places.—Already our coming active participation in the great war is becoming manifest in the industrial world. In New York, for instance, woman is beginning to invade man's realm: at the Bush Terminal it is a common sight to see young women undergoing training as electric-locomotive drivers, electric-tractor operators, crane operators, and in various clerical capacities. Indeed, it appears that when our men don the uniform and take up the business of warfare, the women of the land will come forward and take up their work just as the women of Great Britain, France and Italy have done.

Why the Hand-Rails on Stairs?—The majority of us, subconsciously, no doubt, have come to look upon handrails on stairways as a conventional decoration—a sort of finishing off, as it were. Yet last year 1,149 people were killed and more than 4,000 crippled in the United States alone, on stairways. High heels and run-down heels are largely responsible for stairway accidents, as well as trailing skirts. But in almost every instance the use of the hand-rail could have saved the victims of last year's stairway casualties. Hand-rails are intended for use, and accordingly should be firmly grasped when going down stairs, no matter how confident one may be.

A Grinder that Reclaims Shrapnel Shells has recently been adopted by munition manufacturers for the purpose of removing imperfections from the inside of the steel cases. The shells must be very smooth on the inside, and some manufacturers have had many rejections on account of rough spots on the interior walls. To remove them by the use of scrapers was an expensive process and not altogether satisfactory. However, by means of the new grinder, which consists of a grinding wheel operated by an electric motor through a flexible shaft, it is now possible for certain shell manufacturers to reclaim thousands of dollars' worth of shells that were once rejected. The grinder, continues *Grits and Grinds*, is fitted with a small electric lamp which illuminates the interior of the shell.

Protection of Eyes from Heat Rays.—Information concerning glasses for protecting eyes from injurious radiations is contained in Technologic Paper No. 93 of the United States Bureau of Standards, a publication of 14 pages, which may be obtained at five cents per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C. The work on which this report has been made was undertaken in response to frequent requests the bureau had received for such information. Special attention is given to glasses which shield the eyes from infra-red or so-called heat rays. Data are given showing that of the infra-red rays emitted by a furnace heated to 1,100 degrees to 1,000 degrees C., (1) about 99 per cent are obstructed by gold-plated glasses, (2) about 95 per cent by sage-green or bluish-green glasses, (3) about 60 to 80 per cent by very deep-black glasses, and (4) about 60 per cent by greenish-yellow glasses. At higher temperatures these data would be somewhat different, but not sufficiently so to modify the estimates dealt with in this paper.

Wooden Ships and Ship Worms

By Howard F. Weiss

CLEMENT ADAMS in the reign of Edward VI says regarding the squadron sent out to discover the Northwest Passage—"they cover a piece of the keels of the shippe with their sheets of leade, for they had heard that in certaine partes of the ocean a kinde of worms is bredde, which many times pearceth and eateth through the strongest oake that is."

Although these ships which sailed for the Northwest Passage years ago have long since disappeared, the salt waters of the earth still harbor countless millions of destructive marine creatures, whose presence means certain ruin to wooden ships unless precautions are taken to protect them. Now that our government has decided to break the German blockade by the construction of large numbers of wooden boats, these marine forms of life, little known except to a few scientists and to old skippers, because the modern steel vessels relegated them to the background, again become an important factor in our commercial and national life.

The rate at which wood exposed to their attacks is destroyed is really remarkable. Solid planks six inches thick will be riddled with holes bored by these marine creatures in less than two months. In fact, sound pitch pine piling driven in certain harbors on the Texas coast has been totally destroyed in twenty-nine days! It matters not whether the timber is hard or soft, anchored or afloat, its destruction is certain.

These facts have a very important bearing upon the wooden ships now under construction, especially those being built in southern ports and intended to ply in southern waters. Even though these boats may not be intended to give a long service, the service expected may be much shorter than anticipated unless full measures are taken properly to protect the wooden bottoms from attack. If this is not done, the destruction of these boats is just as certain as though hit with a torpedo.

Although there are many kinds of marine organisms that will attack and rapidly destroy wood, those which occur along our coast can be classified into three genera of mollusks—Xylotrya, Nausitoria and Teredo, all of which are more commonly known as "ship worms," and two genera of crustaceans, Limnoria and Chelura, commonly called "wood lice."

A single female ship worm may lay 100,000,000 eggs a season. These eggs are less than 1-550 inch in diameter and when hatched the tiny embryo swims about for a while and then fastens itself upon wood and immediately

Wooden piling destroyed by Limnoria; the lower section shows original size of piling; upper section amount consumed in two years

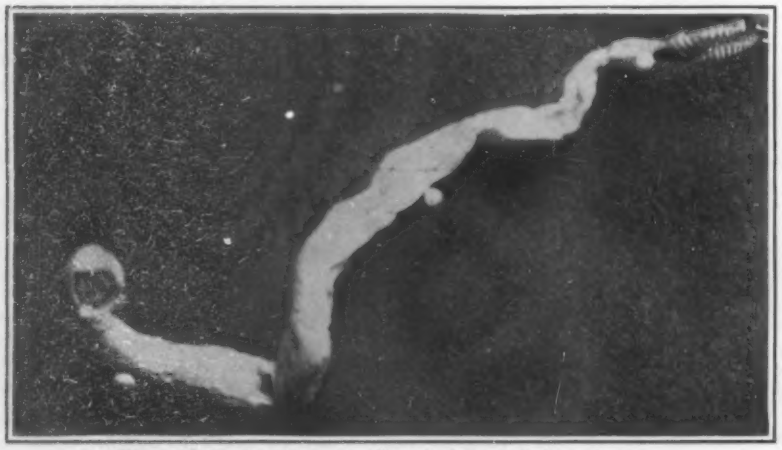
begins to bore. The hole by which it enters is so minute as to be hardly perceptible to the eye, but once inside, the worm grows very rapidly and may attain a length of six feet and a diameter of one inch. The wood quickly becomes honey-combed and, of course, loses its strength and usefulness. The fact that the hole by which the worm enters the wood is so small, is one of the worst features of this creature's attack, because the timber has every appearance of being sound when in reality it is but a shell. Several years ago a sailing vessel, the "Cyrus Wakefield," was moored to a wharf at San Francisco which was thought to be perfectly sound. During the night a strong breeze arose and the ship with the superstructure of the wharf still moored to it was found floating in the bay.

There is some difference of opinion as to the method by which the ship worms bore into wood. It is possible that the body of the worm is held rigid by a suckerlike foot, ordinarily encased within two shell valves, and that these valves revolve around this, cutting away the wood with fine, hard, tooth-like protuberances. It is possible, however, that the muscular ring near the posterior end of the body is pressed firmly against the walls of the burrow, and that the whole body, including the shell valves and foot, revolves in both directions, the shell valves doing the cutting. The hardest knots are penetrated with ease but softer portions of the wood are preferred. As the body grows it secretes a calcareous substance to form a hard lining in the burrow. This is thicker in soft, porous woods than in those which are hard and dense.

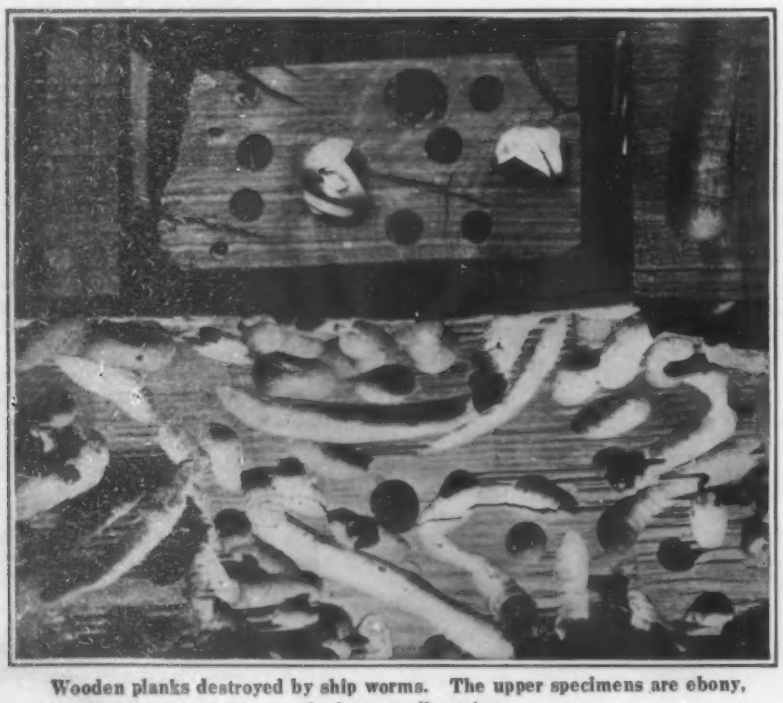
At the posterior end of the body are two siphons Through the shorter one the fine wood borings are ejected; through the longer one water and food are taken in. The food of the ship worm consists wholly of infusoria. The sole object of boring into the wood is to obtain a place for shelter.

All ship worms thrive best in relatively warm water. Certain species have been reported as far north as Eastport, Me. Since warm water increases their activity, ship worms are most destructive from Chesapeake Bay to Florida, and along the Gulf of Mexico, while on the Pacific coast, on account of the Japanese current, their activities extend from Alaska along the entire western coast. The ship worm may be present in some waters and absent in others near by. This is due to a difference in the composition of the water.

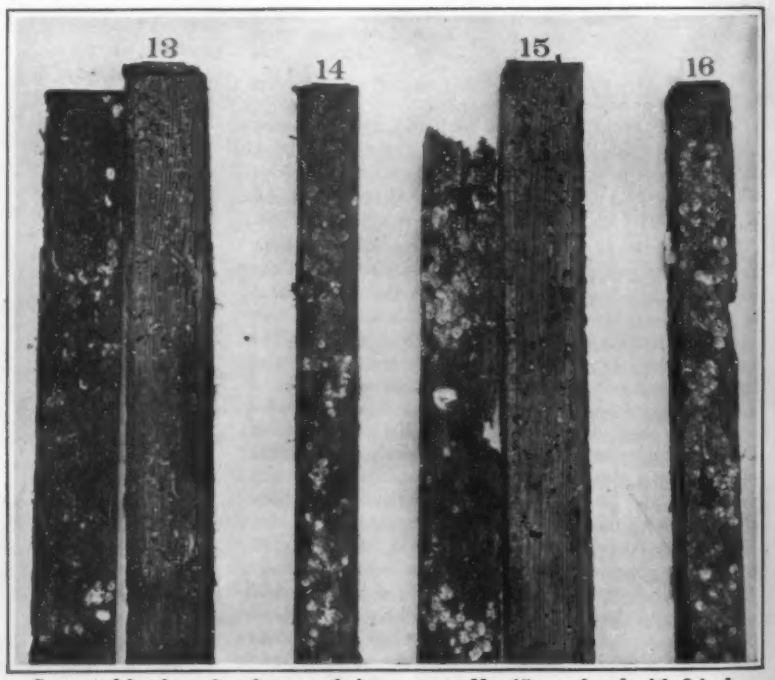
(Concluded on page 601)



Photograph of a ship worm dissected from timber, showing the cutting feet



Wooden planks destroyed by ship worms. The upper specimens are ebony, the lower, yellow pine



Creosoted lumber after five months' exposure. No. 15 was faced with 2-inch planks of untreated wood

Untreated piling destroyed by sphæroma at Jacksonville, Fla. Some of the piles almost cut in two

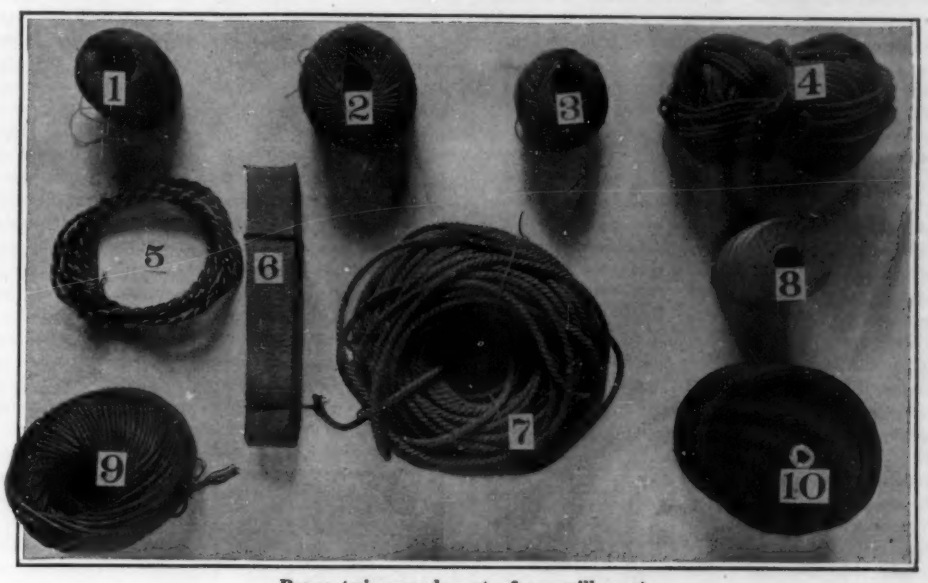
New Woods for Paper Pulp

Research in Forest Products by the Forest Service, U. S. Department of Agriculture

By Dr. Otto Kress

THE results of scientific agriculture are popularly expressed by the phrase "making two blades grow where one grew before," but with forest products the problem is slightly different. The aim is to make one tree do what two did before. For example, lumbering has made the heaviest drain upon the forests and in this industry over two thirds of the material in the forest has been lost while putting the remainder into marketable form. The actual loss has not been so great because the form it is in has naturally made the waste of little value under ordinary conditions. By scientific research, however, it is proposed to develop uses and markets for this waste, and the Forest Products Laboratory at Madison, Wisconsin, was established by the Forest Service, U. S. Department of Agriculture, to encourage research in the forest products industries. These industries employ over a million wage earners, and their products, including remanufacture, are valued roughly at two billion dollars annually.

Investigations are made of the physical and mechanical properties of wood, of methods for the protection of wood against decay and fire, of the use of wood in the pulp and paper and distillation industries, and of the naval stores industry. The laboratory is well equipped with apparatus for experiments on a semicommercial scale, and ultimately a commercial demonstration is made with each problem if experimental results warrant it.



Paper twine made out of sawmill waste

At this time the work on wood pulp is of special interest because of the acute paper situation. The pressure of economic conditions is driving the American manufacturer in those regions where the supply of pulpwood is being exhausted across the border into the virgin forests of Canada. The United States already depends upon Canada for a third of her newsprint paper either in the form of finished product or raw material, and indications are that if the United States is to retain preëminence in wood pulp manufacture she must use her wonderful western and Alaskan resources. Tests by the laboratory have demonstrated the suitability for various grades of paper of no less than ten new or little used woods including Engelmann spruce, lodgepole pine, white fir and other abundant and cheap coniferous woods of the Western States. Experimental pulps from twenty-four such woods were first taken to a commercial paper mill and made into newsprint, which was then used by the New York *Herald* and the St. Louis *Republic* in one of their daily editions. The pressmen expressed entire satisfaction with the manner in which these papers ran through the presses. It was noted that paper from different woods showed a variation in color and a study was undertaken with the Department of Psychology, University of Wisconsin, to determine the effect of color on eye fatigue. Slight variation in color is probably of no real importance. It is doubtful that the average reader has noticed any difference in the color of his newspaper, which is now furnished in the natural shade due to the present shortage of dyes. At least ten of the new woods were entirely satisfactory for newsprint and our own forest resources have thus been shown to be ample to meet the paper requirements of the country.

The laboratory has also developed and applied for patents on a new method of cooking wood by the sulfate process. (Such patents are dedicated to the free use of the public.) Wood cooked by this method has given larger yields of pulp, of greater strength, in a shorter time, and with less consumption of chemicals than with the standard method now used. Cooks were made on thirteen different species of wood and excellent sheets were produced, particularly from spruce, Alpine fir, and western yellow pine. Paper from western yellow pine tested very high and was superior to any other kraft the laboratory has produced. A good kraft was also made from southern yellow pine. While there are a few mills in the South making kraft wrapping paper from sawmill waste, the bulk of such waste is being burned just to dispose of it. The United States produced in 1912 nearly fifty million dollars' worth of wrapping paper, while several times this amount could be made annually from the waste incident to the lumbering of yellow pine in the South.

Kraft differs from other papers, in that it is much stronger, due to less severe action of the chemicals. Large quantities of it are used for wrapping paper, and it is particularly suitable for large envelopes. Spun paper products open up a large field for the use of kraft. Cut into strips, either with one side gummed and spread with a fine lint or used plain, it is run into a spinning machine and twisted into threads. This thread is then woven into such products as onion and coffee bags, matting, suitcases and bags, burlap, furniture resembling reed, coarse mattings, twine, etc.

Onion and coffee bags, matting and burlap made out of spun paper

Studies are being made on the operative features of the chemical pulping processes to determine the effect of varying concentrations, temperatures, pressures, and time of cooking, and also the effect of beating. Overcooking of soda pulp was found to be the cause of "fuzziness" of the finished sheet, and the introduction of moisture during the cooking period was found to increase the yield of pulp 9 per cent. Comparative runs were made by the kraft process on cleaned wood and on uncleaned chips with 4 per cent bark, and also on clear, longleaf pine bark. The chemical consumption by the bark was about 39 per cent, based on the weight of the bark, and the product was of a shiny nature. Mills pulping uncleaned wood should compare the extra cost of barking to that of pulping unbarked wood.

Utilization is, however, being extended to include the bark. Spent hemlock bark gives promise of being important industrially. This bark is now used chiefly for fuel but the laboratory has found that it is possible to substitute it for as much as 30 per cent of the rag stock used in roofing felts. Over 200,000 tons of roofing felt are made annually and the basic fiber material has been rags, many of them imported. The use of bark, if universally adopted, should cut the cost of manufacturing felts in this country a million dollars annually, and at the same time double the value of the bark.

Waste bark is produced as a by-product from the barking of pulpwood preparatory to grinding or chipping, from the tanning industry in the form of spent tanbark, from the veneer industry, and from the lumbering of such woods as cypress and redwood. The various barks can only be looked upon as fillers and will require the addition of longer and stronger fibered stock. Uses that suggest themselves for waste tanbark are the manufacture of indurated fiber ware, wall paper, sheathing paper, deadening and felts. Spruce and balsam bark might be used in the manufacture of wall board and the more fibrous barks, such as redwood, might be used for insulating purposes.

A considerable number of small problems confronting small mills which are of general interest to the industry have been studied. For example, samples of groundwood have been received covered with spots which on examination were found to be a kind of mold which infected the pulp while in storage, and therefore eliminated the need of looking into any of the stages the pulp had gone through before reaching that point. Determinations of the exact species of wood are frequently made when samples are submitted by various manufacturers.

By thus coöperating with the manufacturers the laboratory is able to concentrate on the more important problems and assist in extending technical knowledge of the industry.

British and Russian Science to Coöperate

ACTIVE measures have been taken in Russia during the past year to bring about closer relations between the scientific men and organizations of that country and those of Great Britain. Last October the Imperial Academy of Sciences, in Petrograd, appointed a committee to push this undertaking. One result of the movement which will greatly interest the scientific world in general was the constitution of a committee of specialists, under the direction of the academy, charged with editing two new scientific periodicals, which will present, in French and Russian, a summary of current work by Russian savants. One periodical will be devoted to the physicomathematical and the other to the biological sciences. It is also proposed to have scientific attachés assigned to the Russian legations abroad, and to the British, French and other legations in Russia. The Academy proposes a congress to discuss this subject.

Strategic Moves of the War—June 7th, 1917

By Our Military Expert

WHILE there has been continuous fighting on a small scale along the British and French lines on the Western front, the most significant operations have taken place on the front held by the Belgian forces all the way to the sand hills on the shores of the North Sea. This fighting has been more violent than on any other part of the lines held by the Entente Allies and appears to be the forerunner of a general attempt of the Allies to break through the German extreme right wing. The Germans are apparently looking for an attempt here in view of the heavy artillery fire of their adversaries around Ypres and before Dixmude. The country all along the Belgian front is flat, cut up by canals and waterways, and a most difficult terrain in which to make an advance. If, however, the lines could be broken here, one part of the German army would be driven back onto the seacoast while the other would be pushed back upon the Lys or the Scheldt Rivers and perhaps farther into Belgium. Such a final result would be a victory as great as or even greater than the success already obtained on the Arras or British sector.

Few, if any, have fully realized how thoroughly reorganized and outfitted the Belgian army is now after a lapse of three years since its brave efforts in the defense of the country at the time of the invasion in 1914. Behind their own lines the Belgians are now making their own cannon, rifles, shell and nearly all other material required for the army. This army is now holding and has held for two years eighteen miles of front where special watchfulness is necessary from German surprise attacks to break through in the direction of Dunkirk and Calais and where a weak spot anywhere would lead to an immediate offensive. This watchfulness and strong defense have been of wonderful assistance in enabling the British and French to carry on their own operations without having any anxiety as to the safety of the lines held by Belgian troops.

The raids on the Western front and the increased artillery fire of the last few days lead to the belief that another British drive is in contemplation. The heavy guns are in action all the way from the sea to and below the Scarpe River; but where the blow will fall no one but the General Staff knows, if indeed it has been decided. There is a bulge forward in the English lines around Ypres and another, due to the British gains, in the Arras section; these are to the north and to the south of the great manufacturing center of Lille, and it may be the idea of the British commander to squeeze the Germans out of the country between these two and to free that city. A drive from Ypres in the direction of Roulers and Courtrai would tend to isolate the German forces from that city to the Belgian coast and would force them back out of Ostend and Zeebrugge. If then the Hindenburg lines could be broken at the same time before Douai, the German armies would be forced out of northern France and also out of western Belgium.

This would be in line with the strategy that appears to have been in view since the great advance began in April. It must be acknowledged, however, that German resistance has proven much stronger than was expected after the marked and successful sweep over the Vimy ridge in April. Despite all their losses, it is believed that accessions of troops from the Russian frontier have greatly increased the number of German troops in France and heavy fighting must again be expected when a renewed advance is begun. So far no serious advance by the British comparable with the heavy bombardment has been attempted; fighting in the vicinity of this coal city of Lens seems rather to have in view the testing out of the German forces still holding that city, but the Germans seem to have no intention of giving it up until they are forced to do so. The British have made some progress in driving a wedge into the German lines on the northern side near Loos.

Of late the French have had to sustain the most severe attacks in the desperate efforts that the Germans have made to recover lost ground on the general plateau around Craonne, especially on those parts known as the Californie plateau on the west and the Vauclerc plateau on the east, both at the eastern end of the Chemin des Dames. These attempts finally took the form of a most severe offensive leading to heavy gun and bayonet fighting. The same French troops that took the positions some time ago held out after a most desperate struggle and the battle ended in a repulse of the German forces. These determined attacks can be explained only by the German fear of the constantly expanding wedge that the French are pushing forward between Laon and Rheims.

The Italians in their drive to Trieste appear for the last few days to have entered into a state of consolidation of the positions already taken, though there have been minor clashes along the line. The Italian commander has still continued to drive his wedge into the enemy's lines between Jamiano and Medeazza and also to surround the Austrian left flank on the Carso. The progress east of the village of San Giovanni and Medeazza is a threat against the heights above Duino and against the town itself. The last would permit a move along the seacoast to Trieste; but, as some military observers have stated, the Italians might cut across the Carso plateau due east, cut the railroad to Trieste, and make an advance upon Laibach. However, every report indicates that the principal pressure will continue to be exerted between the village of Jamiano and the sea to turn the Austrian left flank now so strongly supported on the Hermada plateau and on the heights above Duino. These positions on the left, as with Castanavizza toward the center, must be controlled if any advance is to be secure.

The question that appears to have been so well solved in this campaign by the Italians is that of transport in this most difficult country. A railroad line runs from a short distance below Tolmino along the Isonzo through Canale, Gorizia, Montfalcone to Duino and southeast along the coast to Trieste. This road practically parallels the rear of the Italian lines and has been its principal route of supply. But the country to the east—rugged hills and almost inaccessible mountains—has few if any roads and these are only dirt or, worse still, shale or limestone. Nevertheless the Italians appear to have kept their troops along the lines well supplied during their continuous advance of days; this refers not only to provisions but also to the movement of guns, munitions and troops. All items of supply have followed closely in the rear of the advancing forces and have always been on hand in quantities sufficient for the armies' needs.

The operations about Craonne

The Austrians have had similar problems and appear to have solved them possibly as well. But it must be remembered that the Italian forces have been fighting offensive battles against positions long held and fully prepared against assaults. Everything indicates that, of the two, the Italian army far excels in organisation and skill in war their adversaries, who when unassisted, have rarely, if ever, shown marked military qualities.

Little if any news has recently come from the quiet sector of the Albanian front; but that the Allies' plans include offensive operations in every area to keep the Central Powers fully occupied is shown by the reports arriving from that center of the war. It is evident that a strong Allied drive has been begun to sweep the Germans out of Albania and to prevent the Austrians from sending additional troops to the aid of Trieste now so strongly threatened by the Italian army. Fighting all along the lines in Albania from Valona on the Adriatic shore to Monastir in Macedonia is reported. A strong body of Italian troops have had Valona as a base of operations since 1915 and they have now attacked in force the Austro-Bulgarian line to the north and northeast, while the French from Monastir have struck to the west and northwest around Lakes Presba and Ochrida. Despatches indicate that the fighting is on quite a large scale, especially as regards the Italian forces. Valona is only seventy miles across the Adriatic from the great Italian fortress of Brindisi and has been the place of landing of all stores and reinforcements for the army. On the right flank the Italians are supported from Macedonia by both Serbian and French troops. The principal centers of operations seem to be in the valleys of the Osum and Devol Rivers about half way between Monastir and the coast, so that this new offensive is evidently on a large scale.

It therefore looks as if Austria would have to weaken her eastern front against Russia and her southwestern front against Italy if she is to hold back her opponents in this new field. Her position at present seems to be of a certainty a very dangerous one, for she has to defend herself on three fronts, in Albania, along the Isonzo where for 35 miles or more from Tolmino to the sea she has to hold back Italy from the Carso and Trieste, and on the Trentino front where Trent is the objective. The purpose of this Albanian activity may be military or political. If it is a part of the French-Serbian offensive in Macedonia, it cannot go far for the country is not at all suited to military operations on a large scale. It would however, as stated above, draw forces from other points, perhaps from the Carso front. If it is political there is undoubtedly an understanding with the other Allies, since the French are aiding in the movement. If Italy is to have a firm hold in Albania, it is evident that now is the time to strike. This would give her her great ambition—complete control of the Adriatic. It is this control alone that is of such great interest to her for she has quite plainly indicated that, while the Albanians are at present under Italian military control, the annexation of the country is not favored; this applies not only to Italy herself but also to Serbia and Greece. One objection to Albania as an independent state would be the difference in sentiment, feeling, and religion between the northern and southern Albanians which would all lay the seeds for early internal strife, once freedom had been attained.

The Rumanian army appears to have completed its reorganization and to have begun its offensive on the northern end of its lines but so far with no marked success. Before she entered the war Rumania was considered to have the best trained army of any of the smaller states of Europe. The German drive, aided by treasonable acts of high army and other Rumanian officials, swept this army, however, out of practically all the country with the loss of a third of its effective force. Although, apparently so thoroughly beaten, it cannot be said that the army was fairly tested; the present year may give it suitable opportunity to prove itself.

Reports of Russian successes in the Mesopotamian region are so vague as to be unreliable; if true, they will allow the British to continue, on the Tigris to the north, the advance that has now been held up for some time. But the hot weather is at hand with all the difficulties that it brings in its train—rain, the soil, floods, flies and the heat. These combine to make a campaign in the Tigris valley a stupendous task; but all obstacles appear to have been met in a most sensible and thorough manner and are being overcome with success.

If any reliance could be placed upon Russia in the present crisis, a hope might be raised that the war could be ended this year by the defeat of Germany; but the anarchy now prevailing that cannot be controlled by the Provisional Government augurs ill for any extended military operations. The most that can apparently be expected this year on the part of the Russian armies is that they will hold their lines and thus detain a portion of the armies of the Central Allies on their front.

Potash From a New Source—The Blast Furnace

A NEW source for potash has been found. Since the war has shut off our supplies from Germany and so much depends on the cultivation of the soil, every new supply counts.

It has been discovered that large quantities of the dust that accumulates in certain portions of the apparatus used in making pig iron from iron ores—that is, in the blast furnaces—contains appreciable quantities of potash. The amount found depends on the kind of ore used in the blast furnace charge.

As the charge of ore, limestone, coke, etc., passes down the blast furnace, quantities of dust, fine ore and products of the smelting operation are carried out at the top in the gases. From these gases the dust is collected or deposits itself in various places in the system of flues and stoves.

The recovery of potash from blast furnace operation has been particularly investigated by the superintendent of blast furnaces of one of the largest steel companies. He states that the ores used by his company are of such a nature that potash is now more abundantly produced as a by-product than at some other plants using other iron ores.

From April 1st, 1915, to July 1st, 1916, he states that 1,073½ net tons of dust in carloads containing an average potash (K_2O) content of 9.9 per cent were collected. Instead of being dumped into a dirt car, this dust was simply emptied into a central bin. Knowing just what dust to recover, reclamation was commenced after the war started, because of the advance in price of potash, and a satisfactory contract for its sale was negotiated. The company has been disposing of the dust at a good profit ever since.

Work of the Council of National Defense and Advisory Commission

By C. H. Claudy

NAPOLEON'S measure of a man was the answer to his famous question, "What has he done?"

And "What have the Council of National Defense and its Advisory Commission done?" is a question which many ask and few answer, for the simple reason that both have been so busy "doing" they have had little time and less inclination to talk of accomplishments.

Nevertheless, those accomplishments have been very real, and of far greater scope and importance than is generally realized.

Because impossible, in the short space here available, to present more than a sketch of these activities, it is necessary to draw attention to the fact that any mobilization of a nation's resources, be they military or industrial, scientific or human, of materials or brains, requires the immediate solution of an endless list of problems, each one of which may be likened to a cog on a wheel—in itself a small part of the machine, yet which, imperfect or ineffective, may hamper the operation of the whole.

The chart published herewith shows at a glance the organization and the principal ramifications of the Council and its Advisory Commission, and a moment's study of it will differentiate sharply between the two.

The Council itself, meeting every day, hears reports from the Director, and plans, directs and refers matters for investigation and report to the Boards and Committees of the Council and to the Advisory Commission and its Coöperative Committees—The Advisory Commission and its Coöperative Committees report back with recommendations to the Council.

It is hoped, in later issues of THE SCIENTIFIC AMERICAN, to take up more in detail some of the work and accomplishments of both. At present nothing more than an outline resume of the whole can be undertaken.

It is difficult to assign any one activity the premier place in a scale of importance. But as active warfare is impossible without munitions, perhaps the work of the General Munitions Board and the Munitions Standards Board may not unjustly be mentioned first.

Not least among its accomplishments has been the elimination of competitive buying between Army and Navy Departments. Under the chairmanship of Frank A. Scott, vice-president of the Warner and Swazey Company, many conferences with munitions manufacturers, present and prospective, have been held with very definite results. A rifle supply sufficient for one million men has been developed, including arrangements for a sufficient ammunition to be supplied in deliveries satisfactory to the Chief of Ordnance. Manufacturers of artillery ammunition, gun forgings, machiners of forgings, gun-carriages, limbers, caissons, forge wagons, military vehicles and machine guns, have been interviewed, in many cases contracts arranged, in others modifications of existing specifications effected, with the advice and consent of authorities in the Army and Navy. Wherever a lack of material or of sufficient manufacturing facilities has been discovered, steps have been taken to meet the shortage. In some cases this has been done by elimination of non-essential supplies, as in the case of optical glass and military instruments, from the list of which certain instruments desirable, but not indispensable, have been cut out. The coöperation of the Bureau of Standards for the calibration of gages and safe-keeping of master gages has been secured, a most necessary step, since a uniformity of material is an absolute essential both to economy of production and speed of delivery of all varieties of munitions. Add to the above the fact that a confidential list, carefully investigated and comprehensively compiled, of some 660 manufacturers of munition, present and possible, has been submitted to both War and Navy Departments, and it will easily be understood that the General Munitions Board has been able to save millions of government money, simply by its work of coördination of purchases and its elimination of duplication of effort, both purchasing and manufacturing.

The Munitions Standards Board, of which Mr. Scott also is chairman, is organized for the purpose of standardizing specifications, that quantity production at the least cost may be successfully managed. The subject is not one in which details can be made public—suffice it that the work has been done, with the cordial coöperation of the manufacturers of shells, machine guns and explosives.

Much newspaper complaint of the lack of aeronautical preparedness and progress is in evidence. But the Aircraft Production Board, under the chairmanship of Howard E. Coffin, is working tooth and nail to remedy our lack of flying eyes, and has some real accomplishments to its credit, spite of the fact that it has been in existence only since April 17th of this year. United States aircraft manufacturers have been organized in an association, looking to standardization and coöperation. The long standing controversy between the Wright-Martin and Curtiss companies, regarding patents, has been settled in an agreement, at least as far as government contracts are concerned, a most important accomplishment. A comprehensive training plan for army aviators has been developed, in coöperation with General George O. Squier, Chief Signal Officer, and, through the presidents of military engineering universities, six schools for preliminary training of aviator cadets have been started to work. Plans for battleplanes are now being drawn, orders for machines are being placed, a standardized training machine, applicable to English, Canadian and United States services has been developed, the whole production field has been surveyed, school buildings and sites have been planned and in some cases leased (Champlain, Ill., Dayton, Ohio, Detroit, Mich.), and priority of deliveries of machines to various departments is being studied.

Medical Mobilization (treated of at length in a prior article in these pages) has, under the general supervision of Dr. Franklin H. Martin, and the immediate supervision of Dr. F. F. Simpson, been carried far on the way to accomplishment. Twenty-one thousand competent physicians have been selected and certified to the Surgeon General, instruments, supplies and equipment used in Army, Navy, Public Health and Red Cross services have been standardized, eliminating the unnecessary, and in a large measure taking up the slack caused by the complete cutting off of medical supplies formerly imported from Germany. A most important step has been the consultations with deans of medical schools, that the supplies of young medical men be not cut off at the very time fresh medical timber is most needed.

Little is known publicly of the work of the Interdepartmental Advisory Committee, created in March of this year. Yet its efforts to coördinate and thus speed up the work of national defense and to avoid needless duplication of work have been productive of a saving of time and money hardly to be measured. Twice a week, representatives from each of the ten executive departments come together. The Director of the Council, W. S. Gifford, presides over the ten, who are assisted by a representative of the National Research Council. A general tightening up of departmental machinery is aimed at; as an instance of the scope of the work, the formation of all committees by the Council or Advisory Commission is reported, in order that any Executive Department having any information or facilities which would assist such committees may be made available immediately. Similar reports are made to the Interdepartmental Advisory Committee of all recommendations and suggestions no matter whence emanating, that coöperation from the Executive Departments may be immediately obtained. It is obvious that such work must have important results, not the less that individual instances are too numerous to report in detail.

Of the work of the Council in the realm of invention, little can be said, for obvious reasons. The Naval Consulting Board, with Edison at the head, acts as the Inventions Board for the Council. That it has been actively engaged for some time in important investigations regarding a remedy or remedies for the submarine menace will be no news to those who follow events. It is difficult to conceive of so eminent a board failing to produce something of value, but nothing can be said as yet of its results.

A. W. Shaw, president of the A. W. Shaw Company of Chicago, publishers of *System*, heads the Commercial Economy Board, the functions of which are to find out how business may best aid the Government, and how labor, supplies and equipment may best be used in the preparedness campaign without impairment of regular commercial efficiency or the working of unnecessary hardship to the general public.

One result of the work of the Board has been an investigation regarding store delivery and arrangements by which many retail establishments can release men and equipment from delivery service to Governmental use—a plan, incidentally, aimed at one of the many octopus arms of the high cost of living. Economy in retail merchandizing, by a curtailment of return privileges, is being investigated and European experience is being drawn on here for help. Solution of problems of economics in wrapping, packing, reduction of size of catalogs, the reselling of returned bread, modification of the ordinary commercial demands to allow a diverting of supplies to Government use, as, for instance, in the case of raw wool for blankets, even questions of style in garment and footwear, looking to a conservation of materials, are under way.

Coöperating with the Chamber of Commerce of the United States, the Coöperative Committee on the Purchase of Army Supplies is working on such matters as the coördination of railroad and steamship lines entering New York to facilitate shipments to the Allies. It is attempting the relief of food-supply freight-congestion by effecting the prompt release of freight equipment. Buyers in various lines, available as merchandise inspectors, are being found and recommended to the Government, as are competent traffic and shipping men, the services of whom are needed by the Quartermaster's Corps.

The Committee on Coal Production, F. S. Peabody, president Peabody Coal Co. of Chicago, Chairman, has aided the Department of Labor and the American Federation of Labor in the settlement of serious coal labor difficulties. Long hauls of coal to Indian schools and agencies, which can as well use nearer supplies, have been eliminated, thus releasing cars. Increased facilities

(Concluded on page 602)

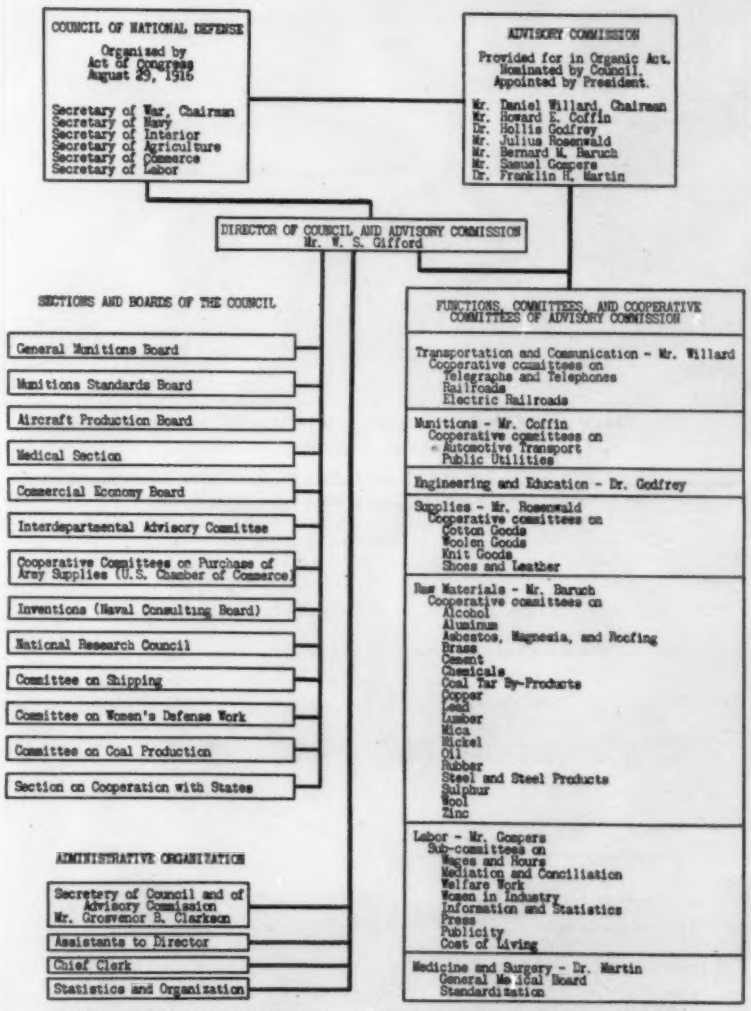


Chart showing activities of the Council of National Defense and its Advisory Commission

Submarine Problem—III.

Nets and Steel Plates as a Defense Against the Torpedo

IT was almost inevitable that in the search for some quickly improvised anti-submarine protection for merchant shipping, the mind should think of the placing of some obstruction in the path of the torpedo, which would serve to arrest or explode it at some distance from the ship.

For the reason that, for many years, as far back probably as the first appearance of a successful automatic torpedo, warships had been protected, when at anchor, by hanging a curtain of steel netting around them, the public jumped to the conclusion that if nets were a good protection for a ship at anchor they must be so for a ship under way—but that is where they were in error. So far as warships are concerned, it had been found that not only was the resistance of the nets so great as to cut down the speed of a battleship to five or six knots, but also that the eddies and other forms of disturbance developed by dragging the huge area of the netting through the water, made it difficult to keep the ships under that complete helm control which is so essential to successful naval maneuvers. Furthermore, as we shall explain later on, although the maintenance of a net at a distance of twenty or thirty feet from the side of a ship by means of booms and guy ropes is not a difficult matter when the ship is in a sheltered roadstead or harbor, it would be an absolute impossibility if a ship were steaming in a gale of wind through a heavy seaway.

And this brings us face to face with a controlling factor, which we commend to all those inventors who are endeavoring to provide protective devices of this character for use on the Atlantic Ocean, namely, that they must plan their constructions so that they will stand the terrific wrenching and twisting forces to which the system will be exposed in a confused and heavy sea.

With this fact firmly established in our minds attention is invited to the following considerations:

1. In view of the large amount of explosive carried in the warhead of the largest torpedoes (400 pounds and over), the net or plating should be maintained at a distance of preferably not less than thirty feet from the side of the ship.

2. The ship so protected, in crossing the Atlantic, is liable, to encounter seas which measure from fifteen to thirty feet in height from the trough to the crest of the wave.

3. While it is true that there is no motion of translation, that is, no movement in a horizontal direction of the great mass of the wave, nevertheless, in the case of a breaking sea or comber, it is possible for a huge bulk of water, several hundred tons in weight, representing the upper portion of a wave, to assume a very high velocity and strike any object in its way with terrific rending and smashing effect.

4. Such a sea meeting a ship end on and striking the booms which hold the nets or plates in position, would snap them as though they had no more strength than so many pipe stems.

5. If the ship were rolling heavily (and the writer has been on large passenger steamers which were rolling over 30 degrees to each side of the vertical) the top of the net or plating would be violently thrust away from the ship in the direction toward which it was rolling and violently pulled over toward the ship on the opposite side, as shown in the accompanying illustration, Fig. 1. If water were elastic and possessed but little weight, this movement might not be of serious consequence; but water is incompressible and very heavy. If a ship were towing nets that were 400 feet long and the lateral movement due to rolling were, say, six feet, it would be necessary for the nets or plate protection suddenly to move approximately one thousand tons of water. This, of course, would be beyond the strength of the booms; they would be either splintered or pulled loose from their eyebolts.

6. It is evident that if such devices are to be towed parallel with the ship, the system must be attached and towed entirely from its forward edge, and be left free to adjust itself flexibly to the various currents and eddies that sweep past the ship in its forward motion.

7. Since the net cannot be supported from the ship's side, it would be necessary to provide it with bouyant structures in the form of pontoons or cigar-shaped floats of sufficient capacity to make it self-supporting.

8. If it were attempted to tow the net in this fashion, it would be found that the rush of water would be sufficient to sweep the mass of the net up toward the surface, and it would be necessary to hold it down, if possible, by a strong steel vertical member at its forward edge. Possibly, in addition to this, it would be necessary to weight the net along the bottom edge.

9. With a view to reducing the heavy frictional resistance, many of our correspondents have submitted schemes for towing a system of large vertical plates through the water. A civil engineer informs us that he tested this method with a fast yacht and found that the individual plates would spring out of line to right or left, and immediately the lateral pressure on the forward outwardly sprung portion would cause that plate to sweep quickly up to the surface of the water.

10. With a view to overcoming this tendency an ingenious modification has been submitted to us by Dr. Nevil Monroe Hopkins of Washington, D. C., which we illustrate in Fig. 3. He describes his device as "a very thin steel band or belt with internally hinged plane surfaces or 'flags.'" "The present device," he writes, "consists of a thin, rolled, steel belt with flag-shaped movable flaps hinged within its area. These steel flaps or 'flags' all stem automatically with the direction of advance and allow the band to be easily drawn through the water in a parallel course to that of the ship, whether attached to its hull, or towed separately by a destroyer." In Fig. 3 we show the plan as thus outlined; and in Figs. 2 and 4 a modification is shown in which the system is provided with vertical as well as horizontal flexibility. In our drawing the belt is maintained in place by a system of booms and guy ropes; but we believe that the only possible method of towing a system of plates like this, or the conventional net, would be to provide on each side of the bow a massive A-frame built up of strong members of box section, the inner ends being incorporated with the upper and lower decks which, at the bow, should be of steel. This A-frame should be rigidly connected both to the top and bottom of the leading edge of the net or plates so as to keep it always in the vertical position.

11. Lastly, we reiterate that if any protective device of this kind is to be successfully employed, it will be necessary to get rid of all booms, guy ropes, etc., and do the towing from the front end, since only in this way can the system be provided with that flexibility, both vertical and horizontal, which is necessary if it is to adjust itself to the conditions of a confused and heavy sea. The A-frame forward would have to be exceedingly strong and the whole bow of the ship would have to be specially strengthened to stand the heavy stresses which would be engendered, particularly when the ship was plunging heavily in a head sea. In order to relieve the sudden and heavy stresses on the towing frame and the forward portion of the net, some form of cushioning device, such as heavy coiled springs, would have to be interposed between the frame and the point of attachment of the towing cables to the net.

Furthermore, in order to make sure that the net was not carried in against the propellers it would have to be towed at least thirty feet from the sides of the ship and at an even greater distance in the case of the largest trans-Atlantic liners.

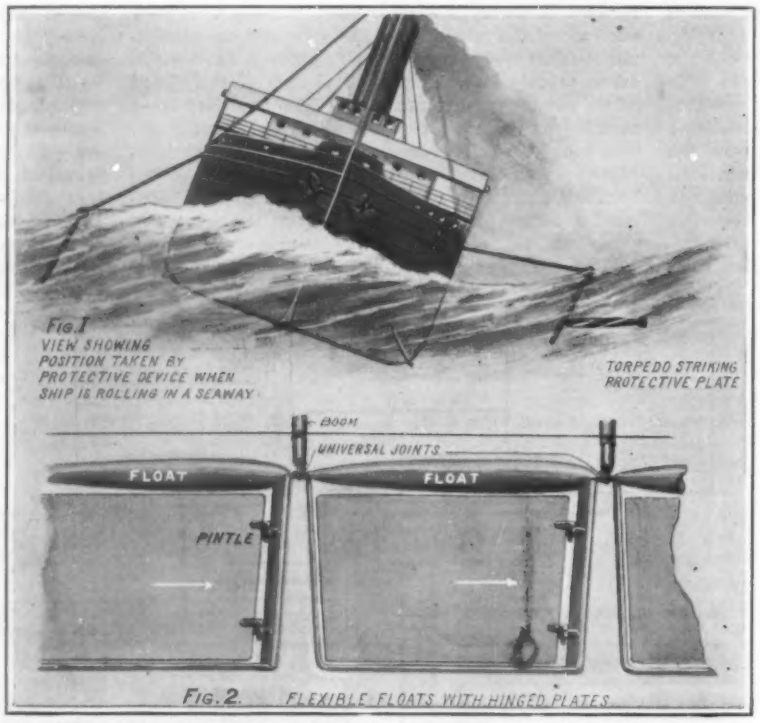
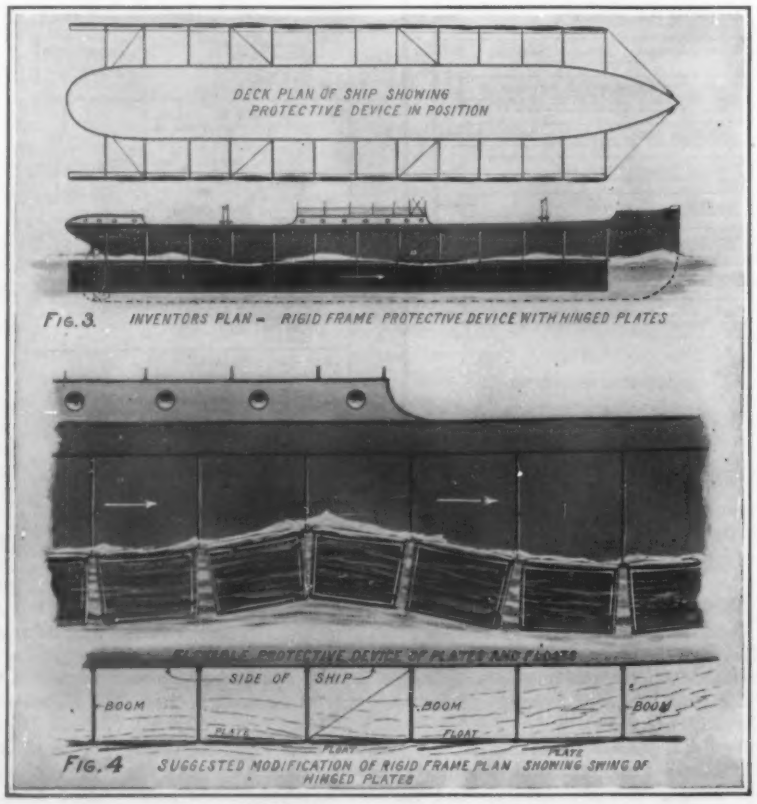


Fig. 1 shows the difficulty of holding nets in place by means of booms in heavy weather

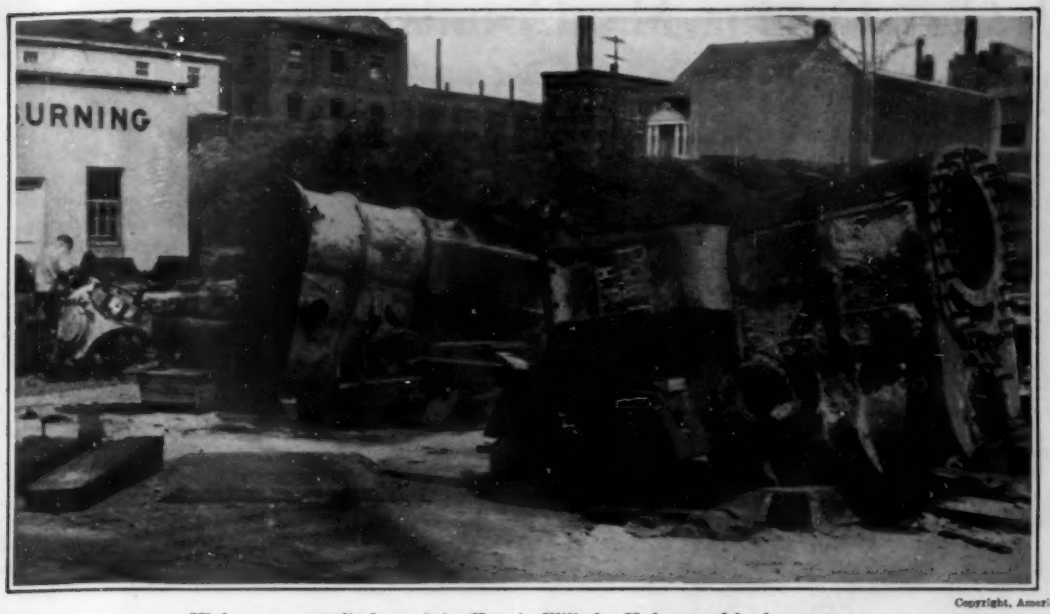


Some methods of towing nets and similar protective devices

How Will Germany Recover From the Financial Strain of the War?

THE German scheme of replenishment after the war has been the subject of much speculation in Swiss business circles. According to reports received at Berne shortly before the break with the United States, a plan was worked out in Germany which contemplated primarily the conservation of the German mark until the return of more normal conditions in Europe. The poorer of two circulating media will always displace the better; and at the very best Germany will have a tremendous paper circulation of doubtful value. Ordinarily this would be held at home and the coinage be exported. To prevent the mark from leaving it was proposed that Germany replenish its depleted stores and stocks with the proceeds of short-term loans and treasury certificates negotiated and sold in neutral countries, notably in the United States. The successful culmination of this plan was to accomplish two things: First, to give to the Germans an exchange medium that is not depreciated and to enable them to liquidate such loans with German wares; second, to give the German mark time to recover its normal exchange value.

A very important part in the work of replenishment was to be assigned to the German mercantile marine. That marine was to be employed exclusively for the German trade. The control of all importations and export prices was to be lodged in government hands, notably in the Zentral Einkaufs Bureau and similar organisations. A governmental guarantee of payment was also to be offered to foreign firms disposed to make 12-month credit assignments to the German trade.



High pressure cylinders of the Koenig Wilhelm II damaged by her crew

Top view of broken cylinder casting

Repairing the Damaged German Merchant Ships

LYING on the wharf in one of the Brooklyn shipyards are various parts of dismantled marine engines, which are so badly damaged as to suggest at first sight that they had been made the target for high explosive shells. Large fragments have been broken out of cylinder castings, so utterly wrecking them that they are manifestly fit only for the junk pile. But it was no bursting shell from an enemy's gun that wrought the mischief; on the contrary, the damage was done in the piping times of peace and with malice aforethought; for the wrecked castings represent two high-pressure cylinders from the German steamship "Koenig Wilhelm II," and the injuries were wrought by the officers and crew when they received instructions from Berlin to disable the ships so that they could not be put in service for several months. It will be noticed that each casting consists of a a high-pressure cylinder and its piston valve. Evidently in disabling the engine the covers of the valve cylinders were removed and a large section was broken out, evidently by heavy sledge hammers and steel wedges. Similar damage was done to the flanged outlet from the steam chest to which the throttle valve was attached.

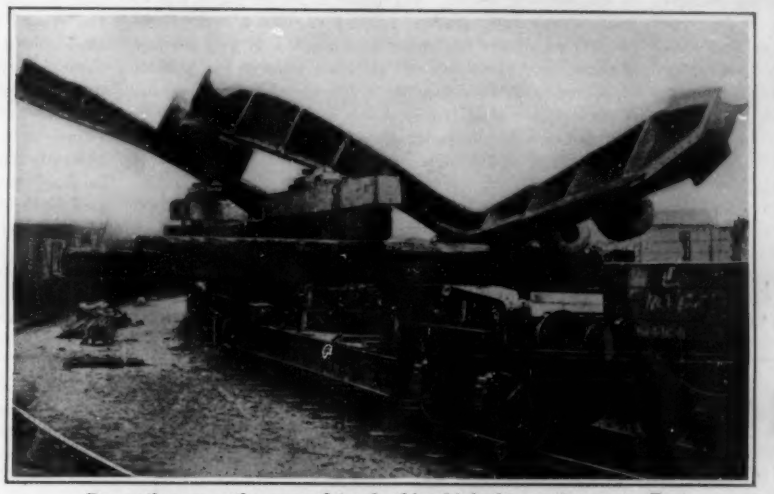
Although we do not possess detailed drawings of the cylinders it is perfectly possible to make accurate patterns of the castings, do the necessary machining upon them, set them in place, and so restore the engines to first-class condition.

The work upon the German and Austrian ships which have been taken over by the Government has been rushed day and night; and some of them are already in service, carrying machinery and supplies to the Allies. The others will be ready to sail long before Uncle Sam's new armies have been trained and equipped ready for service on the Western front.

A Ship's Frame Which Monopolized a Railroad

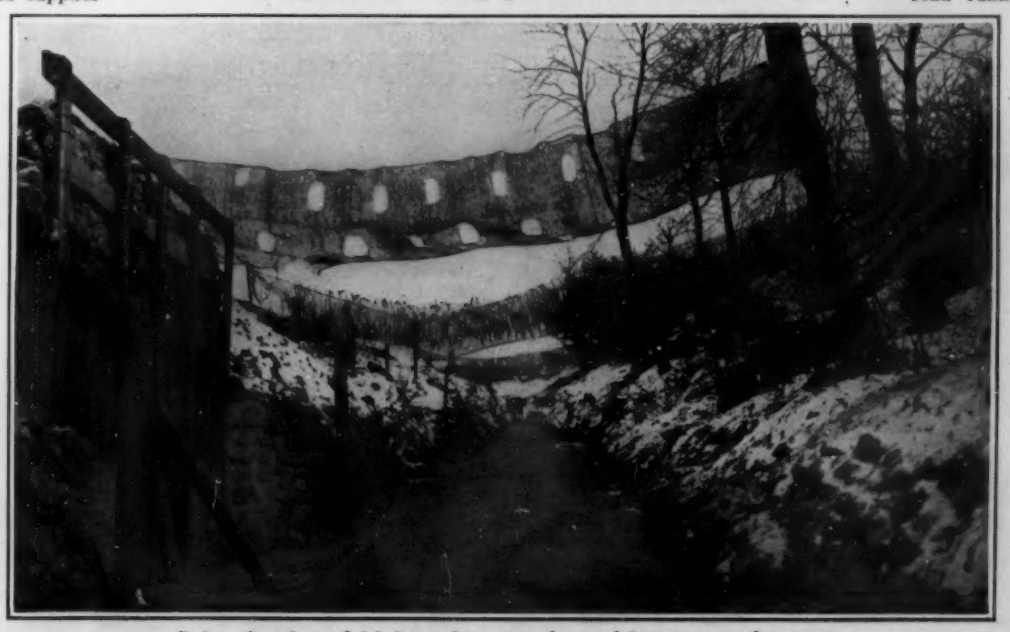
THE accompanying illustration shows how steamship frames are transported in England, from the shipbuilder to the port of shipment.

These members are extremely bulky and awkward of shape and it is impossible to prevent them from projecting beyond the limits of a single railroad track and encroaching upon the right of way of adjoining tracks. If set upright the frame could not pass under bridges or through tunnels and so it is necessary to mount it as shown in the photograph.



Projecting over the second track, this ship's frame ties up traffic

Limbs of trees strung up to deceive the enemy



Strips of perforated fabric used to conceal a road from enemy observers

The long keel portion of the bottom part of the frame, it will be noted, projects ten feet or more beyond the car, overhanging the second line of railway. Such shipments are generally handled on Sundays, since the load in occupying both tracks virtually ties up the traffic of the railroad.

The Art of Camouflage or the Scene Painter and the War

THE longer the present war goes on the more manifest it becomes that modern defensive tactics find expression in large measure in the art of concealment and deception; that is to say, for defensive purposes there is no better protection than the art of camouflage, as the French call it, which means the use of concealment and deception in baffling the efforts of enemy observers and artillery to find a suitable target. Indeed, so important is camouflage today in military operations that the French army has the leading scene painters and artists of the nation at work in this branch of the service.

Camouflage is widely applied in these days of all-powerful artillery when even the stoutest defensive works crumble away under a hail of high-explosive shells. When applied to cannon the art finds expression in a sort of speckled coat of paint or a cover of tree limbs and brush, while in the case of trench work the camouflage treatment consists in placing tree limbs and brush and turf and other accessories over the positions.

Roads back of the lines are usually the target of enemy artillery whose object is to harass transportation facilities. Camouflage, in this instance, consists in the use of either reed screens hung along the side nearest the enemy (in the case of a road running parallel to the lines) or strips of perforated fabric as shown in one of the accompanying illustrations (in the case of a road running at right angles to the front). The latter method has a tendency to break up the straight stretch of road when viewed at a distance or from above, making it confusing and difficult for enemy observers to follow its course.

In the case of railroads, too, camouflage is of utmost importance. In one case where the French desired to protect a railroad an elaborate, life-sized scene was painted on canvas and placed at a bend in the railroad, facing the enemy. Viewed at a distance from hostile observation posts, it appeared as though the railroad ran straight ahead, whereas in reality it curved sharply back of the screen, thus baffling the enemy.

What I Can Do for My Country

V. The Mining Engineer and the Metallurgist

NOW that registration day is come and gone, so that at last the wild crop of rumors regarding this ceremony has given way to the definite results of first-hand observation, the public is in a position to see for itself just what ground our military census covers. It must be clear to the most unthinking registrant that the enumeration was in fact a military census and nothing more. No question was asked or answered that had direct bearing upon anything except the individual's ability to perform effective military service. Moreover the specific and apparently official announcement is made that, as forecasted in the fourth article of this series, for the preservation of our industrial organization sole reliance will be placed in the age limit. There will be no class exemptions extended to farmers or miners or machinists or munitions workers as such; exemption is in every instance to be a personal matter.

This does not mean that our government is ignoring the necessity for securing special services from technical men. It does, however, signify that the mere act of registration under the military census law does not constitute the sum total of the technical man's debt to the nation, and that the man over thirty-one is by no means discharged from all obligation through his exemption from the registration requirement. It is still incumbent upon the technical man of every age and condition of employment to do what he can to put upon record with the proper authorities a complete statement of his special qualifications, so that when work for which he is preëminently fitted arises, he can be instantly identified as the man for the job, located, and brought to the work in question. We may have in the United States ten thousand men competent to take hold of our iron fields and supervise the work essential to doubling their output; but if the executives responsible for steel production do not know who these men are and have no means for immediately finding them, they might as well be still freshmen and floor-boys, they might as well have been enlisted and shipped off to France, as far as their availability in their proper rôle is concerned. And it is to be emphasized again and again that the military enumeration does not begin to cover this ground. It includes only a fraction of the men to begin with, and concerning these tells only the place and nature of their present employment, which plainly is quite irrelevant to their ability to do important work in other lines.

In many fields of engineering the statement that all men should put upon record with the proper authorities a full statement of their qualifications would be, to say the least, a vague one. To the mining engineer and the metallurgist, at the present time, there is not the smallest degree of ambiguity in such a requirement. Most of these men know that the United States Bureau of Mines is taking an inventory of our man-power in their fields; most of them have doubtless filled out and forwarded to the Bureau the little yellow questionnaire. But in distributing these blanks the Bureau has of course to meet and overcome the same obstacle of initial ignorance which we have just mentioned. Full use has been made of engineering societies and employers of engineering talent; yet there must be hundreds of professional and amateur mining engineers and metallurgists who have not received a blank. If you are one of these, or if you know one of these, write to the Bureau of Mines in Washington for a mining engineer's census blank and see that it goes back properly filled out. If you are one of the procrastinators, find your blank or get another, and return it at once, before you forget it again.

A man of keen understanding who possesses a good perspective of the mining industries as a whole will have little difficulty, after inspecting this blank, in picturing the sort of service which the mining engineer and the metallurgist may be called upon to perform. Their responsibility, in general terms, is that of keeping the production of mineral substances even with the demand. There are few indeed of the mineral necessities of modern warfare of which the United States does not possess a sufficient supply, developed or undeveloped, for all the needs of the present emergency. In only four items—manganese, nickel, tin and platinum—are we suffering under a more or less serious deficiency which it is not within the power of the mining man immediately to make good.

Tin is not an absolute necessity, so the shortage here is not alarming. Manganese and nickel our steel makers of course must have; but since the one comes to us now from Brazil and the other from Canada, it is hardly to be anticipated that our supply will be seriously interfered with. In the case of platinum, however, the condition is really a critical one. This metal is the only substance from which it is known to be possible to make contact points for the hard usage which these points receive on the gasoline engine and other apparatus carrying contact circuits. Silver and copper have been tried; but both oxidize too rapidly for satisfactory service, and both allow the formation of arcs which of course constitute a fatal drawback. The situation is further complicated by the fact that the very heavy sulfuric acid requirements of our explosives factories can be met only by the use of an abnormal number of platinum crucibles. Ordinarily we get this very rare metal from Russia; at present the Colombian Republic is making a rather unsuccessful effort to supply us. The mining engineer who will show us where to find a commercial supply of platinum in the United States or Canada, or the metallurgist who will discover a workable substitute for the uses specified, will have made a tremendous contribution toward the overthrow of twentieth century feudalism.

Such matters as this, however, can be attacked with reasonable chance of profit by only a very small propor-

(Concluded on page 607)

Recent Chemical Developments

War Chemistry in Germany; Increased Gasoline Production

By Ellwood Hendrick

FIXING nitrogen from the air to make explosives was an accomplished fact in Germany, and in successful operation before the war was declared. But certain foods called proteins, needed by man and beast, also contain nitrogen although they cannot be prepared in this way. The government food control looked after human needs in a measure, but it could not provide fodder for horses and cattle of a sort containing nitrogen in the right place to keep them going. Five hundred thousand tons of such fodder was annually imported before the war. The need has finally been met by the discovery of a special yeast plant which has a very vigorous growth but produces no alcohol. Under the direction of the Brewers' Institute of Berlin enormous tanks have been set up with proper temperature control and the refuse from the beet sugar works is led into them. Suitable salts are added, including those of ammonium, produced from the air, and these contain the required nitrogen in combination, to feed the yeast, which is said to grow with amazing rapidity. When compressed, it is reported to serve as an excellent nitrogenous fodder and also to be available for human food. The German scientific papers, from which the Journal of the Society of Chemical Industry gathered this information, declare that this will make Germany independent in the future in regard to its supply of nitrogenous feed for horses and cattle.

Another requirement which has been but partially met is oils and fats. The ravages of tuberculosis are in part due to short rations of fats, but the demands of the German war department for munitions containing nitro-glycerin have aggravated this need. To make nitro-glycerin, glycerin is necessary, and the glycerin is obtained by treating fats with a caustic alkali, which results in soap and glycerin. This is explained by the fact that fats are combinations of fatty acids and glycerin and by boiling with an alkali, soap is produced which is a combination of fatty acids with an alkali while the glycerin is set free. So far, chemists have not been able to produce glycerin in any other way than by starting with fats. So, by rigid command, all kitchen refuse containing fats is delivered at a central station where a proportionate amount of soap is returned to the householder and the glycerin is kept for government use.

There is still a great shortage of fats from the lack of imports of provisions, but it has been discovered that horse chestnuts are rich in oil and these are now collected and the oil pressed from them. It is not mentioned whether the oil is edible or not, but it seems to furnish a considerable quantity of glycerin and soap. A little more oil has been obtained by collecting cherry pits by the women of South Germany. The pits are crushed and thrown into a salt solution of such specific gravity that the kernels float on the top while the shells sink. The kernels are then skimmed off and pressed for the oil.

Had the Germans cultivated the very prolific soya bean before the war they would have been much better off now. These beans contain 40 per cent of edible protein and 20 per cent of oil, which, on treatment with hydrogen in the presence of nickel may be changed into a high grade of lard. This is the same method largely used in this country to produce lard substitutes or shortening from cottonseed, peanut and other oils.

The Gasoline Situation

The director of the U. S. Bureau of Mines, Dr. V. H. Manning, made an address to the editors of business publications at their conference in Washington on the present situation in regard to gasoline. It was interesting and full of information; but it does not give us a clear idea as to what the price of gasoline is likely to be next year or the year after. We still have the chance to do all the guessing we want to. One big fact that we have to face is that the production of automobiles has increased 200 per cent above the increase in gasoline production. Thus the total gasoline engine horsepower built and sold in the United States in 1913 was 11,200,000 and in 1915 it was 22,500,000. Of course, this rate of increase cannot keep up, but who knows what it will be? Between 55 and 60 per cent of the gasoline produced is used in automobiles, 20 to 25 per cent is exported and the rest is used in stationary engines, motor boats and for other purposes. Now leaving out of consideration the increased demands for war, there are the constantly improved highways which make motor trucking the natural method of transportation over them. All of our fishing fleets have installed gasoline power and even if the demand for pleasure craft and vehicles should decrease, the industrial requirement is likely to go up in proportion.

In 1916 there were produced in the United States 295,000,000 barrels of crude petroleum. The stock on hand at the beginning of the year was 175,000,000 barrels, and at the end, 150,000,000 barrels, which means that 25,000,000 more barrels of crude petroleum were sold than were produced. As things are going now, unless new supplies are opened up, 1917 will cut down the supply on hand from 150,000,000 to 90,000,000 barrels by the end of the year, besides taking all that is produced.

Now crude petroleum is a very mixed product. It contains varying amounts of gasoline and when this is all distilled off, there isn't any more gasoline left in it. But despite this fact we really do get more gasoline out of it by what is known as cracking. After the gasoline is distilled off the heavier oils come over such as kerosene, export oil, and the various grades of fuel oils as they are known to the market. The valuable lubricating oils are set aside and treated separately. When the heavier and cheap oils are treated by heat and pressure under special conditions and occasionally with certain reagents, they are, as has been said, chemically knocked to pieces, and some of the pieces are gasoline. This is "cracking." The residues may be cracked again and then a third time with decreasing results, but after that they are likely to go back to their original elements, carbon and hydrogen; in other words, to coke. Last year this method furnished 7½ per cent of the gasoline used in this country. Some chemical engineers have such faith in cracking that they believe it will give us enough despite all the danger signals. Among the uncertain factors, however, is the endurance of the present wells and the discovery of new ones.

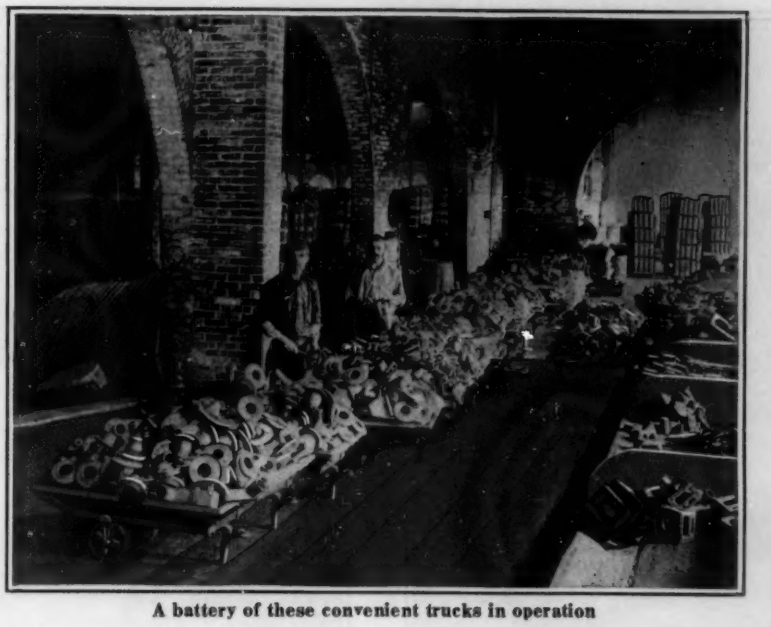
Another source of gasoline supply is natural gas from which, by cooling and absorption, the very light liquids are separated. This is known as "casing head" gasoline and it is so light that it is mixed with heavier oils like kerosene to make motor fuels. It produced 120,000,000 gallons of fuel last year.

So we can argue both ways about the future of gasoline. There are the possibilities of new supplies, of more from natural gas and the certainty of much more from cracking. On the other hand, there is the decreasing supply in storage, which is more convincing than argument or oratory. And the demand for motor fuel is growing like a green bay tree, very, very much faster than the petroleum supply is growing, and cracking is not yet a perfect art. It looks as though we had not yet got past the worrying stage in regard to the gasoline supply.

A Novel Truck With a Detachable Tongue

A TRUCK of novel design incorporating various desirable features is known as the one-man detachable-tongue shop-truck. Roller bearing wheels of large size under the load to insure easy running qualities and a detachable jack-tongue with roller bearing lead-wheel are features of the construction. Modified types with flaring side boards and box or rack equipment can be readily built up from the primary form of simple platform. A supporting foot is provided at the front end to take the load when the tongue is detached.

An especially convenient feature is the jack tongue. Where several trucks are in use, one tongue for each four or five has been found ample. Being removable it is out of the way when the trucks are not being moved. This is appreciated as a real asset and convenience in the narrow aisles of a machine shop when the truck is being used as a temporary storage for parts to be machined. It is also available to use on other trucks.



A battery of these convenient trucks in operation

The tongue may assume any angle when coupled with the truck, which can be turned out of line through a very small radius. It is made of malleable iron and steel, needs little repairing and is not expensive.

The truck boxes and side boards are heavy, and of durable wood, being secured in position with malleable corner irons and bolts. The wooden parts are easily removable when worn out. A type is to be made for special use, as in handling coke or pig iron and sprue charges for cupolas or air furnaces where overhead handling equipment is installed.

A Rotatable Elevator That May Be Pulled About

IN keeping with the efficiency methods of the present day, there has lately been introduced a machine which can be readily wheeled about in the storeroom or warehouse, and which will readily elevate a case, barrel, bale or other object to a given height and then unload it in any direction desired. This is accomplished by means of the simple turning of a crank operating the gear-lifting mechanism, and rotating the turntable base upon which the elevator structure is mounted. When the platform has reached the position desired the cargo can be rolled or pushed off. Still further to eliminate manual labor, the elevator can be operated by means of an electric motor, if desired.

The new elevator, it will be noted in the accompanying illustrations, is a portable lifter or tiering machine consisting of two uprights, an elevating platform and a revolving base, which can swing around on its own center like a turntable. This revolving base. which is fully protected by patents, is a distinct improvement over the old non-revolving base machines, and it is said to make the present type fully twice as efficient as its predecessors. A box, bale, barrel or other object is placed on the platform when the latter is down, and by means of a crank and gears the platform is raised manually or electrically to any level desired and then swung around on its center to a convenient unloading position. Thus the platform can be loaded from any direction, irrespective of the unloading position. Rollers on the platform permit

When at rest, this truck has no handle to take up valuable space

one man to slide the load from the machine directly into the space where it is to be stored.

That the design of the new machine is not a haphazard one is signified by the fact that the standard model is provided with two sets of gears, one for high speed and one for low. Thus loads up to 800 pounds can be handled on the high gear, and loads over 800 pounds on the low gear. While in operation the bases lock together automatically in four different positions, so that there is no opportunity for accidental turning. Another feature is the jointing of the uprights, so that the top half may be folded down to facilitate transportation.

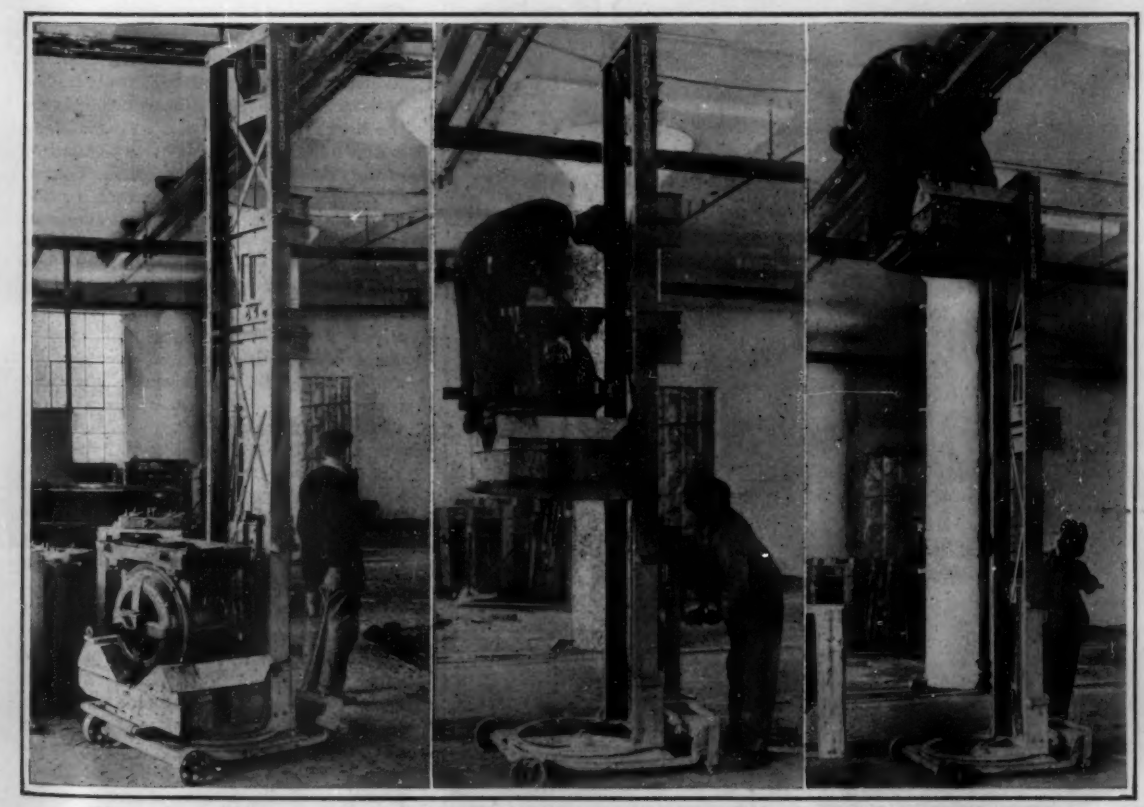
When lowering the platform there is no possibility of the operator being injured by the crank handle flying backwards, as it must be taken off the elevating shaft and put on the lowering shaft to open the brake jaws to allow the platform to descend. The load is sustained independently of the crank, for a ratchet is provided which sustains the load at every point The ratchet and pawl are always in action and cannot be operated by the crank or interfered with in any way Another safety device is the floor-lock, which gives the machine four widely separated points of support. To lock the elevator a steel lever is thrown forward and forced down until the weight of the front part of the machine is lifted off the swivel wheel and is carried by the bearing lugs of the lock. Finally, the elevator cannot upset; anything that is not too large to balance on the platform can be handled in perfect safety, and for unusually bulky loads a base of sufficient size always to keep the center of gravity of the load within the area of the base, can be used.

Recently, quite a number of concerns have been using the elevator for putting up overhead motors, and this method has permitted the installation of from four to six motors in the time formerly required by one. The accompanying illustrations depict the elevator doing service as an electric motor installer, in which case it insures absolute safety in elevating and holding the motor in place while it is being secured to the ceiling, while doing away entirely with scaffolding, special heavy platforms, blocks and falls and other hoisting arrangements which were formerly used for this purpose. The machine can also be used for inspecting the motors and taking them down for repairs, as well as for installing and repairing pulleys and shafting. Indeed, for any work on the ceiling the new machine offers a most convenient method.

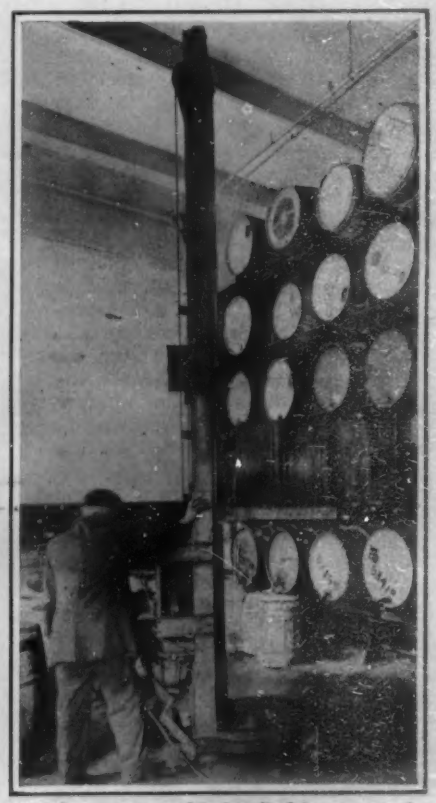
Built from 6 to 20 feet in height, and for loads up to 2,500 pounds, the rotatable elevator can be utilized for any class of work that requires a simple means for lifting heavy loads.

A Register for Plant Varieties

THE committee on varietal nomenclature of the American Society of Agronomy has suggested the creation of a register of cultivated plant varieties, analogous to the herd-books of cattle raisers, giving the history, ancestors, etc., of each variety. Some work along these lines has been done in the classification of oats at the Cornell Agricultural Experiment Station.



Three phases in transporting and raising an electric motor by means of the new portable turntable elevator. This is a simple and expeditious method of installing electric motors



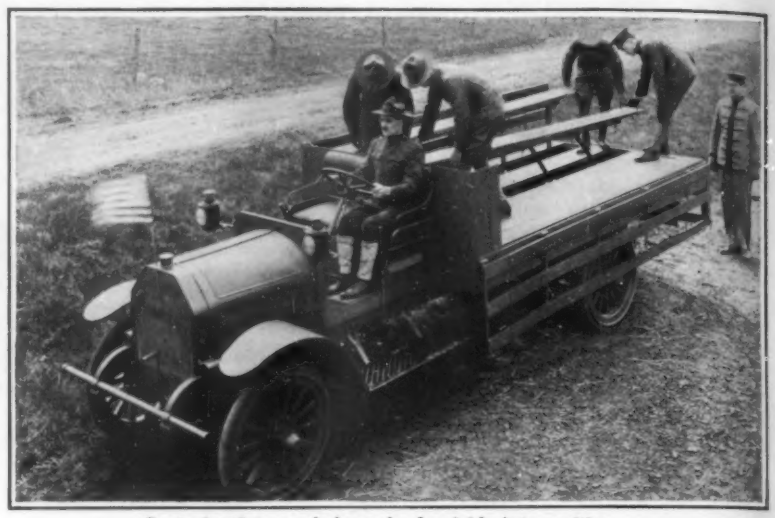
Oil drums are readily handled by means of the electrically-operated elevator

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Convertible motor truck body arranged for carrying supplies



Seats for the men being raised quickly into position

Combination Army Transport Truck

A COMBINATION truck body that can be employed to transport freight or soldiers has been recently built and tested out. The usual form of freight carrying body cannot be used to carry men for any distance, because it is not provided with proper seating accommodations. If seats are provided, these must be arranged around the sides and the truck cannot be utilized to its full capacity. Of course, the men may be carried standing upright, but this is not practicable if the journey is to consume any time to speak of, or if the roads are poor. The accompanying illustrations show the method of converting the new combination stake, side-platform body, best suited to carry supplies, to a special form adapted for carrying four squads of eight men.

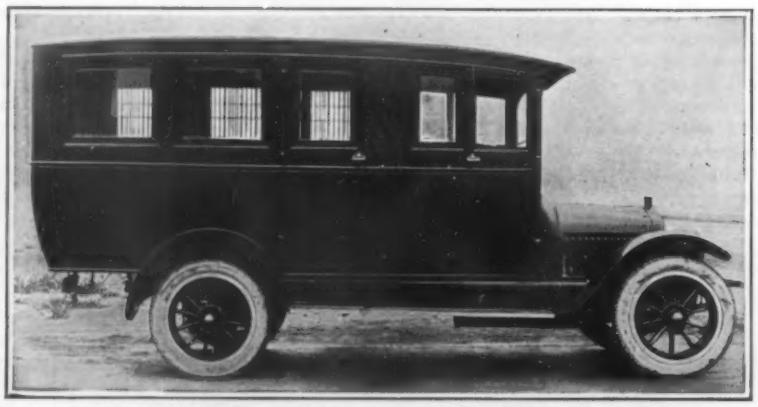
This truck is two and one half ton capacity and is equipped with a body that is only 6 feet wide by 12 feet long, and carries conveniently 32 men, minimum load, and can transport 38. There are three rows of seats placed longitudinally and the men sit astride of them as on a horse. By this method of seating less room per man is required, every available inch of space is utilized, practically increasing the seating capacity 100 per cent. These seats can be dropped in three minutes, thereby giving a flat platform or a stake body which can be used for transporting freight, baggage or other supplies.

With this type of body construction, more men and weight can be transported than ordinarily, as the large number of men are an important factor when bad road conditions are encountered. In actual tests over bad roads, it develops an ease of motion greater than the average passenger automobile. It is claimed that a non-convertible strictly passenger truck with moderately extended frame built on this principle can transport as many as sixty men. The chassis on which this body is mounted is a standard model following the very latest specifications that the War Department issued in April.

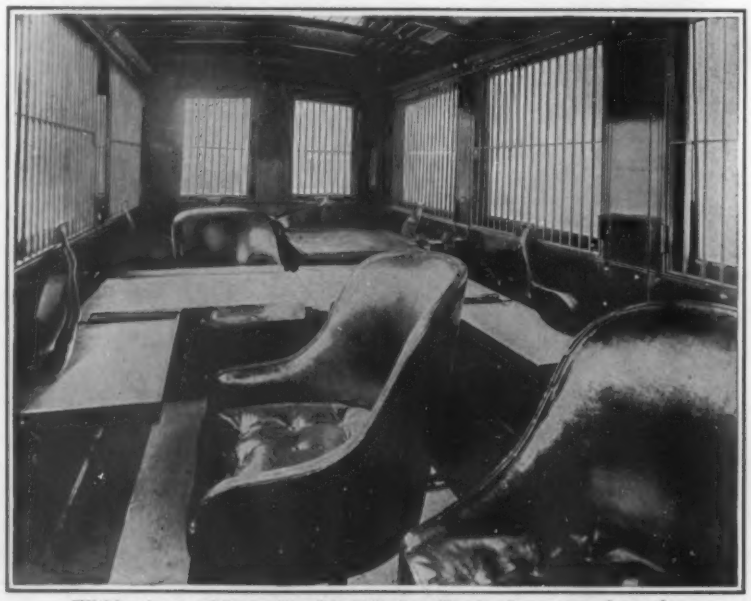
Seated astride the seats instead of side by side, four squads of men can be accommodated in a single load

Bandit-Proof Pay-Car Body

A MOTOR truck with a specially designed body containing all the conveniences of an office and protected against highway bandits, is used by the Chicago Surface Railway Lines to carry the pay envelopes of thousands of its employes to car barns and other widely scattered districts. In some cases the truck merely transports paymasters and large sums of money from one car barn to another. In others, trips of several miles are made into the country to pay off line and track men and gangs engaged in special construction work, such as the building of new bridges, tunnels, buildings and general track improvements.



Exterior of bandit-proof pay-car mounted on a standard chassis



Within the steel-barred body of the bandit-proof pay-car where the payrolls are made up while the truck is *en route*

The truck has accommodations for four paymasters, a chauffeur and a guard, all of whom go heavily armed. The paymasters are provided with swivel chairs and work at tables which hang on hinges and may be dropped down when not in use. The table in the center of the office, as shown in the accompanying photograph, is used for making up payrolls while the truck is *en route* and within easy reach on either side are shelves for money trays. The windows are protected by iron bars and connected with an alarm system. In paying direct from the truck the chief paymaster sits at the extreme end of the office, takes the pay envelopes from the shelf and passes them out to the workmen through a wicket in a window on his left. While the men are receiving their money the guard stands on duty in the rear of the office and the chauffeur guards the front. When the truck is traveling through the streets all money and other valuables are carried in a special steel vault built in the body of the truck behind the rear seat

Tractors and the War

THE Tractor Standards Division, of the Society of Automotive Engineers, of which H. L. Horning is Chairman, is coöperating in several fields of tractor progress, including that having to do with the heavy ordnance work. Mr. Horning is a member of the Automotive Committee of the Advisory Commission of the Council of National Defense, as representing the tractor interests. The manufacturers of passenger cars, motor trucks, parts and accessories for automotive apparatus, aircraft, watercraft and motorcycles are also represented on this committee which has within its jurisdiction some matters of a commercial nature, as well as those involving engineering problems. The great potentiality of the farm tractor in the solution of the world's food problem is, of course, well appreciated. Many points are, however, involved in the adequate production and use of farm tractors. The average farmer does not understand sufficiently the merit of the tractor as a tool for him and is not trained as he should be in the operation of the mechanical apparatus. Any machinery ever produced requires some attention at regular intervals. There are well-known cases of tractors which have failed in the hands of some owners and been highly successful in the service of others who had some adequate knowledge of the attention actually required by the machines. The agricultural press is rendering a national service of the highest value in making plain the require-

(Concluded on page 603)

Wooden Ships and Ship Worms

(Concluded from page 592)

Xylotrya is able to endure the brackish water in New York Harbor, while the Teredo cannot live there except in the outer water, outside the Narrows. Observations along the Chesapeake Bay and the Gulf of Mexico indicate that the ship worms found there will thrive in waters with a saline density indicated by a specific gravity of from 1.0054 to 1.0333. They work in absolutely clear and in very turbid water, but seldom to a depth of over thirty feet. The worst attack is usually in very salty, warm and clear water.

The "wood lice" are entirely different in their method of attack, as they eat away the outside of the wood, hence their presence is easily determined. Further, they make much smaller holes than do the ship worms, these being seldom more than $\frac{1}{16}$ inch in diameter. The attack is usually centered upon a limited zone above and below a low water mark.

Limnoria are reported by the United States Fish Commission as rarely occurring at a depth of 40 feet. They have a wider temperature range than the ship worms but require pure salt water and cannot exist in dirty or fresh water. Limnoria are found along the Atlantic coast from Nova Scotia to Florida and in waters of the Gulf of Mexico. They also do great damage on the Pacific coast.

In addition to the organisms mentioned, there are two other varieties which are very destructive on the east coast, the Pholas and the Sphaeroma—the former is chiefly a stone borer but will also attack wood In form it resembles a clam. It bores by bracing its open shell against the sides of its excavation, while its long sucking foot emerges and rubs the surface of the stone or wood. Particles of sand are operated between the foot and the stone or wood, thus grinding the excavation. All kinds of stone are attacked. These organisms have been discovered in creosoted government barges, where they have bored holes that were one-half inch or more in diameter clear through the planks.

The marine borers just described have been the subject of much study on the part of the Government and others, and various methods of combating them have been devised. Contrary to common belief, impregnations with dead oil of coal tar or creosoting are by no means proof against attack. Creosoting ship timbers is very apt to damage certain classes of cargo on account of the fumes which arise from the treated wood. This would be particularly true in regard to food stuffs, now so badly needed by our allies.

Frequent painting with copper paints proves effective, provided the bottoms of the boats are thoroughly and frequently painted. The practice of nailing an untreated piece of wood to the keel of wooden boats painted with copper paint in order to act as a "trap" and then removing this strip of untreated wood after attack is a poor one; because, as shown by Dr. Shackell, it is far more difficult to kill marine borers after they develop than when they are in the embryonic stage. Of course, if this "trap" is removed before the borers pass through it and into the hull proper little damage will be done.

While copper paint is an effective preventive against attack, there is still much room for an improvement in the production of a marine paint, which will not only prove resistant to the attacks of the marine borers and to sea water, but which will withstand mechanical abrasion.

Perhaps the most effective means of protecting wooden ships from attack is to sheath their bottoms with copper. As long as this copper sheathing remains intact, an absolutely protective covering will be had, but if the smallest hole should occur in this sheathing, the marine borers will immediately reach the wooden hull.

Another efficient means of arresting attack is to run the ships into fresh or brackish water and keep them in this water for two or more days. This will kill all of the worms that may be in the timber. Unfortunately, this simple means of protection is not available except in a comparatively few harbors along our coast.

Work of the Council of National Defense and Advisory Commission

Concluded from page 595)

for storing of Navy coal have been arranged, and the acute situation for the supply of coal to the Government buildings in Washington has been relieved. A conference of Great Lakes shippers of coal and ore, railroad and vessel owners, has resulted in such a consolidation of cargoes and elimination of waste time that an increased carrying capacity of coal and ore of two and one-half million tons has been provided.

The National Research Council maintains in Washington an active committee, working under the Council of National Defense, under the Direction of Dr. George E. Hale and Dr. Robert A. Milliken. Representing the scientific forces of the country as well as the research bureaus of the Government, the National Research Council is at present engaged in investigations of detection means for completely submerged mines and submarines, range finders, detectors for invisible aeroplanes and sappers, improvements in wireless, military photography, prevention of electrolytic action on metal hulls, balloon fabric, slicker fabrics, new explosives, utilization of wastes and by-products, the nitrate supply and optical glass problems, anti-toxins and serums and other medical problems, sterilization of drinking water, soldiers' clothing and blankets, the study of occupational diseases with special reference to the conservation of health of munitions workers, ear protection from high explosive shock, protection from poisonous gas, etc., etc. For military reasons no public report of results obtained are available but it can be said that the best scientific brains of the country are thoroughly mobilized, under the direction of the Council, for all such investigations as make for scientific, inventive and discovery preparedness for war.

The Department of Coöperation with the States has done wonderful work in bringing these political units of the United States together in a coherent whole, looking to the use of state machinery to the good of the nation. Many eastern States had state boards or councils of defense prior to the formation of this active department under the immediate charge of Mr. George F. Porter. Since its formation, however, forty-four States show such organizations. A conference of representatives of all such councils, committees of public safety, etc. has been held in Washington in which the entire forty-eight States were represented, twelve of them by their governors. Information of the work of the various state organizations and their activities has been tabulated, and an intimate relationship between these organizations and the Council of National Defense perfected, with the result that the National Government is at all times in close touch with the preparedness work of its several political units.

The Advisory Commission and its subcommittees have been doing an immense amount of constructive work, which should have pages instead of the few paragraphs available here. Under the leadership of Commissioner Daniel Willard (President of the B. and O.), a complete mobilization of the nation's railroads has been effected, through the special committee on national defense appointed by the American Railway Association. In effect, this mobilization is to make the railroads of the United States one system for war purposes, eliminating red tape and the commercial factor and, in some measure at least, approaching the wonderful transportation efficiency of the German Government railroad system which has meant so much to our enemy in his warfare.

This is not a paper accomplishment. Coal is being given preference in car supply and movement, ore comes next, car service rules have been modified to facilitate free movement, passenger service is being modified and curtailed to expand freight service, nine reserve engineer regiments of skilled railway workers to aid France in rehabilitating her railways have been organized, food movements have been simplified and made faster—in fact, the whole railways service has been speeded up for governmental and economic preparedness in a way which warring commercial interests held to be impossible until the contrary was shown by actual accomplishment.

The same course of procedure in telegraphic and telephonic communication has resulted in the elimination of lost motion, not only between companies and the Government, but between company and company. The number of long distance wires has been increased, perfect long distance service between Washington and headquarters of all Army and Navy divisions has been arranged, special drills for more than twelve thousand long distance operators the country over have been taking place, over ten thousand miles of special wire systems have been diverted from commercial use to the exclusive service of executive departments, the Bell system, coöperating with the Coast Guard is installing telephone connections at 100 light houses and 200 life saving stations, including the laying of 1,200 miles of wire and 300 of cable, etc., etc.

The Committee of Supplies, Julius Rosenwald, President of Sears, Roebuck & Co., Chairman, is composed of six eminent men from as many lines of business, all serving without pay. It has many accomplishments to its credit, first of which has been the elimination of the advertising and bidding method of government purchase, satisfactory in peace times even though leading to competition and inflation of price, but too cumbersome and slow for war. The committee has largely stopped the Government from competing with itself in the open market, by similar purchases through different channels. New specifications, required by existing trade conditions, have been written for many supplies; the middleman is being eliminated as far as possible, options on great quantities of important supplies have been secured and a vast amount of money saved the country.

The Committee on Raw Materials, Minerals and Metals, Bernard M. Baruch, Chairman, has saved the Government ten millions on the purchase of 45,000,000 pounds of copper. Twenty-five million pounds of zinc at two-thirds the market price have been secured, several hundred thousand tons of ship plates bought at $58 a ton instead of the commercial price of $160 a ton, and aluminum, chemicals, oil and a hundred other materials purchased at prices correspondingly below the market rates.

Samuel Gompers, President of the American Federation of Labor, is Chairman of that Committee on Labor which has done such fine work for the Council and the Government. Too long to detail here, these labors are typified by the patriotic coöperation promised the Government by organized labor everywhere, and by the adoption of that resolution which advises "that neither employers nor employees shall endeavor to take advantages of the country's necessities to change existing standards." It is believed that to a very large extent this will result in the complete elimination of the strike and the lockout during the war.

The Council has more than 27,000 detailed reports in its files of manufacturing plants the country over showing capacity and product. It is almost wholly the work of Mr. Howard Coffin's Committee on Industrial Preparedness. His work has been too vast for even a summary, but the Committee on Automotive Transport must be mentioned on account of its success in connection with the Quartermaster Corps, in perfecting truck specifications by which millions upon millions of dollars will be spent.

There are any number of smaller ramifications of the work of Council and Commission—only the high lights have been touched upon here. But it would be unfair to close this outline without mention of the fact that the Council and Commission both are almost entirely composed of patriotic citizens who work without compensation, in the full knowledge that not by fighting alone, but by fighting backed by coördinated industry is a modern war to be won.

How We Burn Up Our Property

(Concluded from page 589)

Listing the exposure loss in accordance with this opinion, we find that of the State's aggregate fire loss for a representative year, $16,168,628 or 80.5, was preventable, while but $3,906,783, or 19.5 per cent, was not preventable. These results are apparently typical, at least so far as can be gathered from comparison with other states.

It may not be out of place to say a word or two about the organization that compiles these and vast quantities of similar figures. For many years each fire insurance company made up its own figures. No company covered any territory completely, reporting only on the losses which it itself had paid. Moreover, no two companies used exactly the same classification of causes, or quite the same tests for determining where to tabulate a loss in which the matter of judgment entered. Consequently there was no accurate statement possible even of our total fire loss, let alone of the various contributing causes.

A couple of years ago several of the larger companies got together and organized a national board to handle this matter of fire insurance statistics. It was not merely a question of idle curiosity; it was realized that reliable and complete figures as to the causes of all our fires would make possible a far more intelligent adjustment of premiums. Offices were secured in New York, and, as it became evident that the movement was in no sense an effort of the big fellows to impose their control or even their methods upon the little fellows, everybody came in, until now the board represents fairly the entire fire insurance interest of America.

Every company that pays or refuses to pay a fire loss is under obligations to forward to the headquarters in New York a blank, completely filled out, which tells everything there is to tell about that fire. These blanks are put through the mill by a large force of girls, much in the same fashion as that described in these columns in connection with the recording of the Connecticut Military Census. Only here we have a vastly greater amount of detail. Every fire has to be recorded on a card to be filed in alphabetical order under the name of the victim; every fire has likewise to be recorded on another card for filing geographically, under town, street and number. In addition, full information as to the loss and the cause has to be gleaned out and recorded separately. At the end of the year it is a tremendous task to make up the summary for each state and for the Union.

The activities of the board do not end here, however. It is not merely desired to know why we have fires, but to educate us not to have them. To this end the board is constantly distributing information and suggestions, and trying to train the public, by small degrees, to exercise the reasonable care against fires which it seems so little disposed to exercise. Eventually, too, the board will be in possession of information that will weed out the chronic offenders. When the individual file has been running for ten years, say, it will be a most interesting study to see who the people are who have from two to ten fires each year, and in what places this habit is most general.

Tractors and the War

(Concluded from page 600)

ments that can be met easily by reasonable effort in the forward march of intelligent modern farming.

There is no manner of doubt that a great deal of tractor development, as an immediate result of military activities, is at hand and in sight. The most spectacular feature of this development is the military work but the production of crops in greatly increased quantities is a consideration second to none in the national welfare. The work of the Society of Automotive Engineers applies at many points of contact and the results that will be achieved by it through well organized proceedings now in effect will be as important and striking as any with which this organization is to be credited.

NEW BOOKS, ETC.

A MANUEL OF DIAGRAPHOGRAMS. By William Martin. Published by the author from Providence, R. I., 1917. 16mo.; 46 pp.

As stenographers know, a diagraphogram is a shorthand character used as an abbreviation for a word or group of words, such as "President of the United States," "Department of Commerce and Labor officials" and "Your Honor and Gentlemen of the Jury." To express such phrases in one easily written symbol is to effect a considerable saving of time; the collection here offered contains some eight hundred of these diagraphograms.

THE JUDGMENT OF THE ORIENT. By K'ung Yuan Ku'suh. Edited and rendered into colloquial English by Ambrose Pratt. New York: E. P. Dutton & Company, 1917. 12mo; 72 pp. Price, 60 cents.

The mouthpiece of this "judgment" is said to be a Chinese student and traveler; there is nothing in the brief volume, however that might not have emanated from an occidental endowed with keen observation, an original trend of mind, and a well-concealed sense of humor; often we feel uncertain whether we are being given glimpses of a fantastic eastern philosophy or whether the author is having his little joke at the reader's expense. He begins with a masterly psychoanalysis of the chief warring nations, but passes to a delightfully ingenious "soul-sex" theory in which woman—or the woman-soul—is held responsible for the great conflict. Even in the wildest fancies there is a deep undercurrent of satiric truth that gives us a highly profitable, as well as pleasurable, hour. Women and Germans, however, will scarcely appreciate K'ung Yuan Ku'suh; his judgment is decidedly against them.

HEALTH AND DISEASE. Their Determining Factors. By Roger L Lee, M.D. Boston: Little, Brown, & Co., 1917. 8vo; 394 pp. Price, $1.75 net.

Any distinct betterment of the public health must largely depend upon education of the individual; more and more the individual is cooperating with the physician in the preservation of health and the avoidance of disease. Dr Lee, recognizing the importance of this awakening desire, has given his readers a summary of medical knowledge that is much more comprehensive than is usual in books addressed to the layman, full of distinctive features and vital conclusions. His work sets forth not only the principles which should guide the individual, but also those which should govern the community; the history of disease and of medicine is sketched, and some intimation is given of the fields still to be explored. No one can seriously follow this exposition of the underlying principles of health and disease without acquiring a knowledge that is power. The work may be especially recommended to employers, social workers, public health officers, and general practitioners as a sound summary of preventative medicine.

ANIMAL MICROLOGY. Practical Exercises in Zoological Micro-Technique. By Michael Guyer, Ph.D. Chicago: The University of Chicago Press, 1917. 8vo.; 300 pp.; illustrated. Price, $2 net.

This revised and enlarged edition of Professor Guyer's favorably known text will be welcomed by both teachers and individual workers, offering, as it does, a service of wide scope. Its particular viewpoint, however, is that of the beginner, and it is the beginner who should most appreciate the way in which microscopical technique has been stripped to its essentials, subsidiary information being relegated to memoranda following each chapter. Every statement is clean-cut, its meaning unmistakable, the exercises are time-saving and practical, and disclose numerous little tricks of technique that sometimes make all the difference between good and bad results. Appendices deal with the principles of the microscope, standard reagents and their uses, tissues and organs with methods of preparation, the preparation of microscopical material for a general course in zoology, equivalent weights and measures, and bibliography.

GOVERNMENT PARTNERSHIP IN RAILROADS. By Mark Wymond. Chicago. Wymond & Clark, 1917. 8vo.; 192 pp. Price, $1.50.

American railroads represent a value of some sixteen billion dollars, and 1,800,000 men and three and a half billion dollars are annually involved in their upkeep. They are now facing a crisis due to "the politician and the ignoramus," and it is essential that the problem should be met and solved. The author concedes government regulation to be necessary, but it must be such as not only secures for the public reasonable rates and fair practices, but also protects railroad investment and assures it a fair return. Proper equipment and maintenance are of prime importance, and new capital must be obtainable at fair rates of interest. The government, the author holds, must see to it that this new capital is properly applied and economically expended. The main section of the work is devoted to constructive suggestion designed to remove present defects and evils, and the result of our attempt at regulation through ninety-three independent government agencies is itself condemned as an evil. The plan proposed cannot with justice be summarized in a brief review, but it seeks to bring about a community of interest between railroad owners and public, to effect a wider distribution of ownership, and to stabilize the value of railroad securities by consigning speculative features to the background.

ELEMENTS OF MINERALOGY, CRYSTALLOGRAPHY AND BLOWPIPE ANALYSIS. By Alfred J. Moses, E.M., Ph.D. and Charles Lathrop Parsons, D.Sc., D. Chem. New York: D. Van Nostrand Company, 1916. 8vo.; 643 pp.; illustrated. Price, $3 net.

The aim of this textbook, now in its fifth edition, is the development of skill in sight recognition and rapid determination of common and economically important minerals. In its enlarged form it adds descriptions of new economic groups and species which industrial progress has forced us to recognize; it discusses formations and occurrences in recognition of the value of mineral genesis in diagnosis and in connecting geology and mineralogy; and it offers a more detailed section on crystallo-optics, with new determination tables. Two of the new features are particularly worthy of notice: a simplified method of classifying and identifying real crystals by partial symmetry and angles, offered as a substitute for the usual course involving symbols and axes, and the assembly and description of the gem minerals in a separate chapter. The authors, one professor of mineralogy at Columbia University, and the other chief chemist of the United States Bureau of Mines, are eminently qualified by their combined experiences to present significant facts in an orderly and readily understandable manner.

THE DESIGN OF MACHINE ELEMENTS. By W. G. Dunkley, B.Sc. New York: D. Van Nostrand Company, 1917. 12mo.; 214 pp.; illustrated. Price, $1.50 each volume.

This work of British origin sets forth the main principles on which the design of machine elements is based. The first volume deals with forces and stresses, shafting and bearings, couplings and springs; the second takes up screws and bolts, clutches, belts and pulleys, and gearing. The subjects are well presented, with clear explanatory illustrations and numerous tables. Those interested in engineering design will find in the work very concise and valuable expositions, and information of decided value in convenient form for reference.

THE FOUNDER'S MANUAL. By David W. Payne, Editor of *Steam*. New York: D. Van Nostrand Company, 1917. 8vo.; 688 pp.; 245 illustrations. Price, $4 net.

Almost any information pertaining to modern foundry operations may be dug up from scattered publications—if time is no object. The author brings most of this material together in one volume, in logical arrangement. The beginner, as well as the more advanced worker, has been steadily kept in mind; both student and foreman may be very sure of finding, through the exhaustive index, any knowledge they may need to acquire. Their everyday problems, whether of materials, mechanics, or chemistry, are here solved, and the multitudinous appurtenances and operations of the cupola, the core room and the molding room are carefully explained.

SELLING YOUR SERVICES. New York: The Sales Service Company. 8vo.; 176 pp. Price, $1.

It is rather strange, when we come to think of it that with all our endorsement of efficient methods in business and industry little has hitherto been done to put the applicant in the way of efficiently seeking a job. "Selling Your Services" is full of meaty suggestions and pertinent pointers, from the advice to the ambitious one not to overlook his best prospect—his present employer, to the injunction to meet his prospective employer's point of view and to "keep his case alive." The letter of application, the follow-up letter, references and the personal interview are all dealt with in a common-sense way; any applicant following the advice here given will undoubtedly have a great advantage over his uninstructed rivals.

MENTAL CONFLICTS AND MISCONDUCT. By William Healy, Director Psychopathic Institute, Juvenile Court, Chicago. Boston. Little, Brown and Company, 1917. 8vo.; 341 pp. Price, $2.50 net.

THE PSYCHOLOGY OF SPECIAL ABILITIES AND DISABILITIES. By Augusta F. Bronner, Assistant Director of the Juvenile Psychopathic Institute, Chicago. Boston: Little, Brown and Company, 1917. 8vo.; 278 pp. Price, $1.75 net.

When we stop to consider that we have all been through the great experience of childhood, it is remarkable that so few of us arrive at anything like a true understanding of children. How many, for example, realize that undesirable traits often originate in a mental conflict that is quite dissimilar in nature to the effect it produces? That a perverted development of sexual ideas may produce the runaway or the thief? Dr. Healy's important work cites numerous specific cases, traces their aberrations back to the hidden cause, indicates the proper handling of misconduct problems, and gives parents, judges, and court and institution officers a practical basis for the reinstatement of normal mentality in delinquents. Dr. Bronner takes up the pbolem of the child from the intellectual rather than the ethical point of view; her life-work has furnished her with a wealth of problem-cases, and of methods that have proved successful in such cases. She discusses practical aspects of special abilities and disabilities, sketches various types, and suggests remedies. Defects in number, work, language, mental processes and mental control are cited, and the chapter embodying general conclusions may be particularly commended to the educational investigator.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14219) F. B. C. asks: Are the occupants of an automobile absolutely insulated during an electrical storm?

Could they be injured or killed by lightning even if the rain was heavy and the outer tire wet on account of the inner tube? A. The occupants of an automobile would not be insulated in a thunder storm. The only insulation would be the rubber tires and three inches of rubber would be scant insulation for a charge of electricity which had pierced perhaps a mile of air. The occupants would be better protected if there was no insulation at all, as there would not be if the tires were wet. If the frame of the auto were of metal the protection against lightning would be the best which could be had. Inside of a metal cage a person will be safe from lightning. The charge will be carried by the metal bars of the cage to the earth, and will not penetrate the interior of the cage. A discharge would be more likely to strike the iron of the motor than the wood of the top of the car, and the occupants would not be in great peril from lightning in a storm.

(14220) S. T. asks: A number of years ago (possibly 20), I think I secured from your columns the name of some ingredient that applied to glass would give appearance and texture of ground glass of fine enough grain for camera work. Can you advise me what this was? A. To make a coating on glass which is finer than ground glass for photographic work, proceed as follows: "Put into three ounces of water 35 grains of starch. When the starch is thoroughly wet, boil the mixture until it is as clear as boiling will make it. Then strain through two thicknesses of a linen handkerchief. This quantity of starch in three ounces of water will not jelly when cold. We usually apply it to the surface of the glass when cold, but whether there is any advantage in this we are not certain. It will not flow over the glass like collodion. A glass rod will be necessary to get it all over the glass. Then let it run off leaving as much as you require. Place it in a level position, protected from dust till dry." This method was furnished us in 1893 by one of the best photographers in the country, as his method of making a focusing screen for his most exacting work. We reprint it for the benefit of our readers.

(14221) J. H. F. asks: Is there any dope that can be added to water that will increase its explosive force when brought in contact with a red-hot iron surface? Or in other words, what will increase or produce a greater steam pressure when water is injected into a red-hot vessel or tank? Also please state whether a powerful searchlight, one that will penetrate the atmosphere for a hundred miles, would be able to penetrate clear water as much as 100 rods? A. 1. There is nothing known to us which will cause water to be converted more suddenly into steam to give a greater pressure when injected into a red-hot vessel. 2. There is little reason to suppose that a searchlight can penetrate water at a distance of 1,650 feet. Ordinarily water has quite too much sediment in it for that.

(14222) J. A. V. asks: Do you know of any book published that would give us the compositions of different solids and solutions such as sulphate of Iron? We would call this a dictionary of chemistry. A. You will find the composition and description of all the more common chemical substances in any good text book of chemistry. We can supply you with MacPherson and Henderson's General Chemistry for $2.40 postpaid. Sulphate of iron is a compound of iron and sulphuric acid. Its common name is green vitriol. You would hardly require a dictionary of chemistry for your purpose, since a dictionary of chemistry enters into all the particulars of the preparation and uses of the various chemicals. We can, however, supply you, if you wish it, with Watt's Dictionary of Chemistry, 4 Volumes, for $50.

(14223) N. Z. aks: Does heat and cold act the same on brass and copper as on iron and steel I have found in my experience, for instance, playing a cornet when cold the pitch is low, when warmed up it rises in pitch considerably; and for the reason that both brass and steel is used for balance wheels in better grade watches, I take it that heat and cold acts opposite on these two metals. A. The pitch of a wind instrument rises when it is warmed because the air in it is more elastic when it is heated and vibrates faster. When a cold cornet is blown the cold air gives a low pitch. After a little time the metal becomes warm and the pitch of the tones is raised. It is the same whether the cornet is made of silver or of brass, but silver will become warm quicker than brass and the effect will pass away sooner with a silver cornet. The balance wheel of a watch is made of steel and brass, so adjusted that it vibrates in the same time at all temperatures to which the watch is liable to be exposed. All metals expand when heated, and contract when cooled, but different metals expand and contract to different degrees for the same change of temperature.

FOREIGN COMMERCIAL NOTES AND QUERIES

Manufacturers who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The publisher of the SCIENTIFIC AMERICAN *assumes no responsibility as to the financial standing of concerns or individuals. Address all communications to the Query Editor of the* SCIENTIFIC AMERICAN, *Woolworth Building, New York.*

544.—A commission merchant in Spain wishes to purchase electrical supplies or secure an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

545.—A Brazilian merchant, who is at present in the United States, is in the market for knitting machines for making lightweight hosiery. Quotations should be made f. o. b. New York. Payment will be made by cash against documents in New York. Correspondence may be in English. Catalogues and full information in regard to capacity of machines, etc., should be submitted. Reference.

546.—The street-cleaning department of a city in England desires to purchase motor-suction street-drain cleaner and other street-cleaning devices. Quotations should be made c. i. f. destination. Payment will be made on delivery of goods.

547.—A firm in the Canary Islands is in the market for machinery and chemicals used in the leather-tanning industry and chemicals used in making soap and shoe polish. Quotations should be made f. o. b New York. Cash will be paid. Correspondence should be in Spanish. Prices and full information should be submitted.

548.—A SCIENTIFIC AMERICAN correspondent in Southern India is in the market for hosiery machinery, also apparatus for distilling and extracting products from wood

549.—A correspondent in Siberia desires particulars relative to machinery for a sugar beet plant, also equipment for raising sugar beets. Correspondence may be carried on in English.

550.—A correspondent in Calcutta wishes information relative to an oil-pressing plant. Castor seed, linseed, and will install a cotton seed plant later if it is possible. Complete estimates and blue-prints are required, for small plant, the machinery preferably being worked by bullock power.

551.—An Anglo-American Agency in Helsingfors, Finland, has been established for the exclusive purpose of introducing American and English products into Finland and Russia. The firm will be glad to act as agents for any American manufacturer or exporter whose goods are likely to sell in this part of Europe. Correspondence can be carried on in English.

552.—A correspondent in Bombay desires (First) a machine for embossing names and addresses on aluminum name plates, in one, two or three lines automatically.

Second. Address of the maker of a hand or foot-power weaving machine which would make woven name plates for linen.

Third. A coin-controlled slot machine for playing a game of cricket.

553.—A correspondent in South India desires to get into communication with firms making stationers' glassware and watchmakers' machinery.

554.—A man in Spain desires to represent American manufacturers and exporters of automobiles, selling for about $1,000 and $1,800. Quotations should be made c. i. f. Cadiz f. o. b. New York. Separate quotations are desired for chassis. He is also interested in tires, lubricating oils, greases, and other accessories. Payment will be made by cash against documents at destination. Correspondence should be in Spanish. References.

555.—The street cleaning department of a city in England desires to purchase 60-horse-power vacuum motor road sweepers, with a speed of 12 miles per hour, driving brush 7 feet 6 inches long and 4 feet in diameter, and with a velocity of 360 revolutions per minute. Cash will be paid on delivery.

556.—An Argentine business man, who is now in the United States, wishes to secure agencies for the sale of hardware, tools, and materials for making tents and sails. References.

557.—A commission merchant in Spain wishes to purchase electrical supplies, or secure an agency for the sale of same. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

558.—A foreign purchasing commission in the United States desires to place orders for large quantities of petroleum, such as is used by the United States Navy.

559.—A man in Panama is in the market for one portable sawmill. Catalogues and specifications should be submitted. Quotations should be made c i. f. and f. o. b New York. Cash will be paid Correspondence may be in English. References.

560.—A commission merchant in Spain wishes to buy or secure an agency for the sale of electric-fan ventilators. Payment will be made through a New York bank. Correspondence should be in Spanish. References.

561.—A manufacturer in Spain is desirous of securing an agency for the sale of toys. Quotations should be made c. i. f. destination. Cash will be paid. Correspondence should be in French or Spanish. References.

562.—A Swedish business man, now in this country, is going to spend several months on a trip in Sweden and would like the agency for some nationally advertised articles (automobiles excluded). Correspondence can be in English.

563.—A man in Uruguay is in the market for complete machinery and equipment for producing and refining ether and chloroform, with a capacity of from 110 to 220 pounds of ether and 44 to 110 pounds of chloroform daily.

564.—A man in Italy would like to secure an agency for the sale of electrical apparatus and supplies. References.

565.—A company in Australia desires to purchase machinery and equipment for making sugar of milk from by-products of cheese or casein, with a capacity of 10,000 to 20,000 gallons per day of twenty-four hours. Quotations should be made f. o. b. San Francisco. Payment will be made by cash through New York commission house. Correspondence may be in English. Full information in regard to formula for making the milk, etc., should be submitted. References.

566.—A foreign consular officer in Italy is desirous of representing American manufacturers and exporters of agricultural machinery. Quotations may be made f. o. b. New York. Cash will be paid, but credit terms are preferred. Correspondence should be in Italian or French. References.

567.—The managing director of a firm in Australia, who will be in the United States after May 1, is in the market for 20,000 feet of 6-inch artesian bore casing.

What I Can Do for My Country

(Concluded from page 598)

tion of the engineering fraternity. By far the greater bulk of our mining men will turn their attention rather to the ordinary and extraordinary utilization of known mineral deposits. This will involve first of all the use of two or even three shifts in many large mines which have been working at but a fraction of their extreme capacities; and of course there will result a heavy draft upon the supply of competent supervisory talent. Then there will be extension of present production by means of new shafts and headings, new smelters and reduction plants. There will be opening up of fields long known but never worked; there will be reopening of many mines and headings abandoned as worked out or left to wait their turn pending the working of neighboring veins of higher grade ore. There will be extension of modern methods of intensive mining by dredging, hydraulic work and steam shovel to properties which have never been subjected to such wholesale operations. There will be experimental bores and prospective tunneling on a very large scale.

All this will involve a great deal of engineering work of a great many different sorts, and every mining engineer in the country can find a share of this work exactly commensurate with his particular abilities. The expansion of production will be confined to no geographic region, to no select few of our minerals or metals. It will be as nation-wide as our workable mineral deposits, and it will include everything from coal and iron through the steel alloy metals and the rare earths to gold and silver.

Nor is the greatest significance to be attached to the purely active part of the engineer's work. Of course, his active services are necessary; but in a sense they are subordinate in importance to his services as a source of initial impulse. Those with authority to proceed toward expansion and intensification of an industry in most cases lack the knowledge upon which to base effective procedure. The best intentioned board of directors in the world cannot decide intelligently which of its active properties may be stimulated to best advantage, where it can most profitably substitute new methods for old and what new methods are eligible for consideration, or any of the other points which must be involved in the effort to enlarge production. It must submit such points to competent engineers; and when it does this it must ordinarily wait, for a very considerable time, upon the engineering investigation necessary to formulation of an answer.

We are anxious to avoid such delay where possible. By proper individual action of our engineers we can to a great extent accomplish this. Every mining engineer who reads this page has half a dozen pet projects slumbering in the back of his brain. It may be a wonderful deposit of nickel which he located years ago when looking for something else; it may be the substitution of steam shovel or hose for blasting in some particular place where he is sure such substitution would work; it may be some radical improvement in the reduction processes in use on a certain type of ore; it may be the recovery of some residue which has always gone into the dump-heap; it may be any one of a thousand and one other items of development, improvement or conservation. In any event, now is the time to bring the pet scheme out of its retirement and present it to the owners, operators, or prospective lessees. Sometimes it will be so practicable on its very face that it can be adopted offhand; sometines it will require investigation. In any event, if it goes through, it can go through with much less preliminary motion than is ordinarily the case.

We do not, of course, wish to convey the impression that the nation is about to turn out *en masse* and tear up the whole landscape in frantic search for new sources of metals. Nevertheless, it is plain that the phenomenon thus expressed in violently exaggerated terms will, to a certain extent,

actually be witnessed. It is not sufficient that the engineers help out this process by giving their best services where these will be of most avail; they must be equally willing to give their best knowledge and best ideas where these will be of most avail, even though in so doing they must give over their cherished schemes into the keeping of others. And, of course, as we have so often said that it has come to be almost a platitude, they can accomplish none of these things if they enlist for military or naval service. The Government will undoubtedly recognize this, and assign such of them as are drafted to special service; let those who are not drafted then recognize it also, and assign themselves to such service.

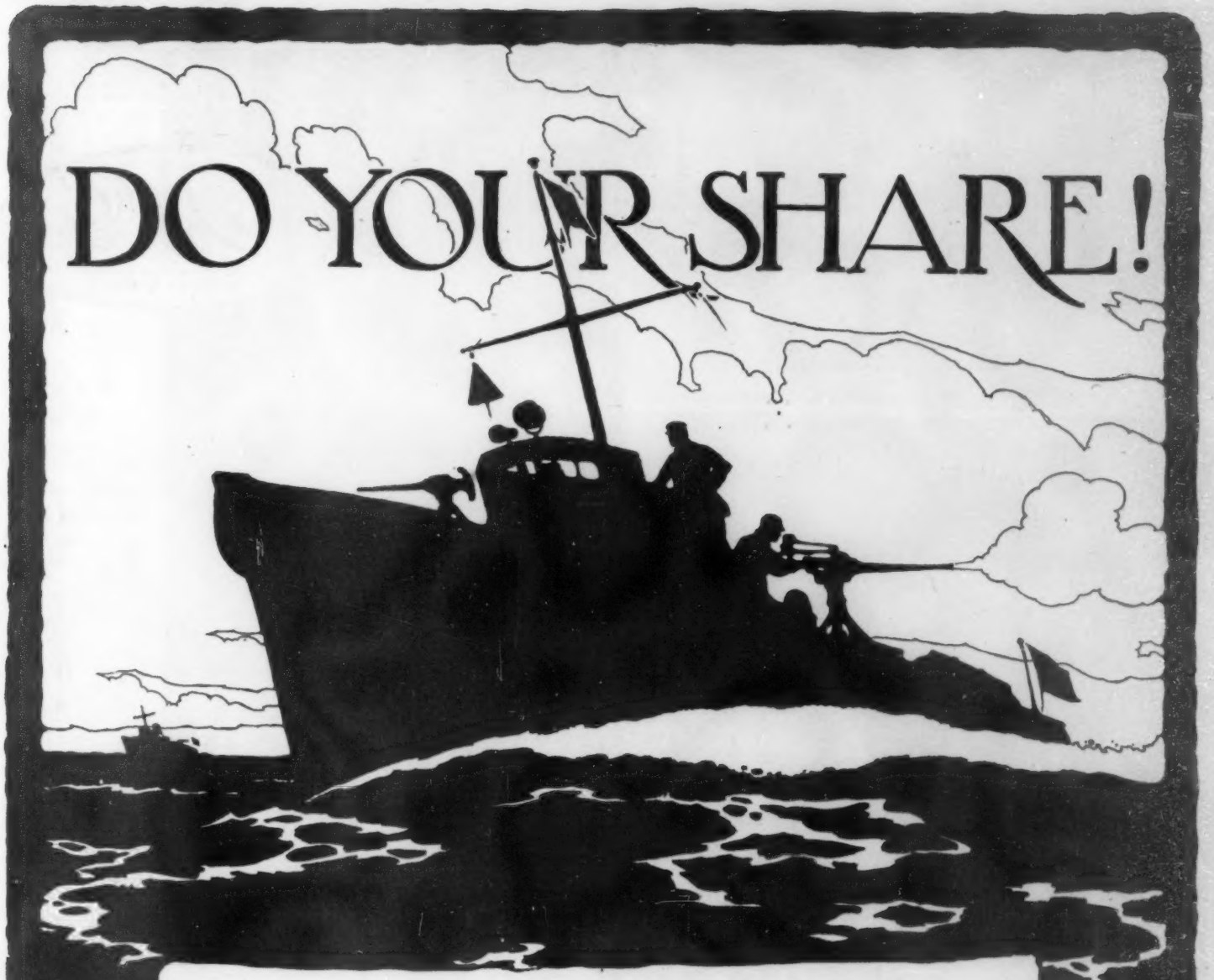
The Current Supplement

A SUBJECT that has been attracting attention recently is the proposed construction of wooden ships to make up for the ravages of the German submarines. An article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2163, for June 16th, on *The Revival of Wooden Shipbuilding* gives a brief description of how this kind of a vessel is constructed, and touches on some of the objections to the plan for building a big fleet of these obsolete craft. It is illustrated by a number of photographs. *American Indian Languages* is a valuable anthropological study that will be widely appreciated. *Detecting the Pretense of Deafness* describes some ingenious methods and apparatus that have been adopted in France to deal with men who seek to avoid military service. It is accompanied by several explanatory illustrations. *Flicker Phenomena* is a short illustrated investigation of the effects of intermittent flashes of light on the eye. *A Motor Car Railway Mowing Machine* describes and illustrates a novel device for cutting the weeds alongside railway tracks. *The Foundry Today* is an interesting survey of apparatus and methods employed in the iron-casting industries. *Physiographic Subdivision of the United States* discusses a report of a committee of The Association of American Geographers, and includes a chart showing the genetic classification of land forms adopted. In most studies of efficiency in business and manufacturing graphic charts are largely employed to summarize and illustrate results, but, on account of defective methods employed in constructing such charts, the impression conveyed is frequently erroneous. The article on *Graphic Charts that Mislead* explains this condition of affairs and tells how the results of statistical facts should be illustrated. It is accompanied by a large number of cuts. *Cotton and Wool Finishing Processes* discusses problems of chemistry, physics and mechanics in an important branch of the textile industry. *Chemicals for Laboratory Use* considers the reliability and purity of reagents employed in chemical investigations and their production. *Recent Developments in Molecular Physics* reviews a discussion before the Royal Institution at London.

Investigating the Strength of Hollow Tiles

A SERIES of investigations of the strength of hollow tiles as developed in walls of varying thickness has been started at the United States Bureau of Standards by the construction of a number of these walls 5 feet long by 12 feet high. The walls so far constructed are of three thicknesses—6, 8 and 12 inches. Those already laid up have been set with the tile on end. It is proposed to construct walls of similar size with the tiles placed on their sides. Other variables will enter into the work, and when the investigation is completed about fifty will have been built. Some of these will be tested by direct compression; others by applying a load across the middle of the side with the purpose of determining somewhat the ability of these walls to withstand wind pressure.

Some of the data will be made available for the American Society of Testing Materials, which is now engaged through one of its committees in adopting specifications for hollow building tile.



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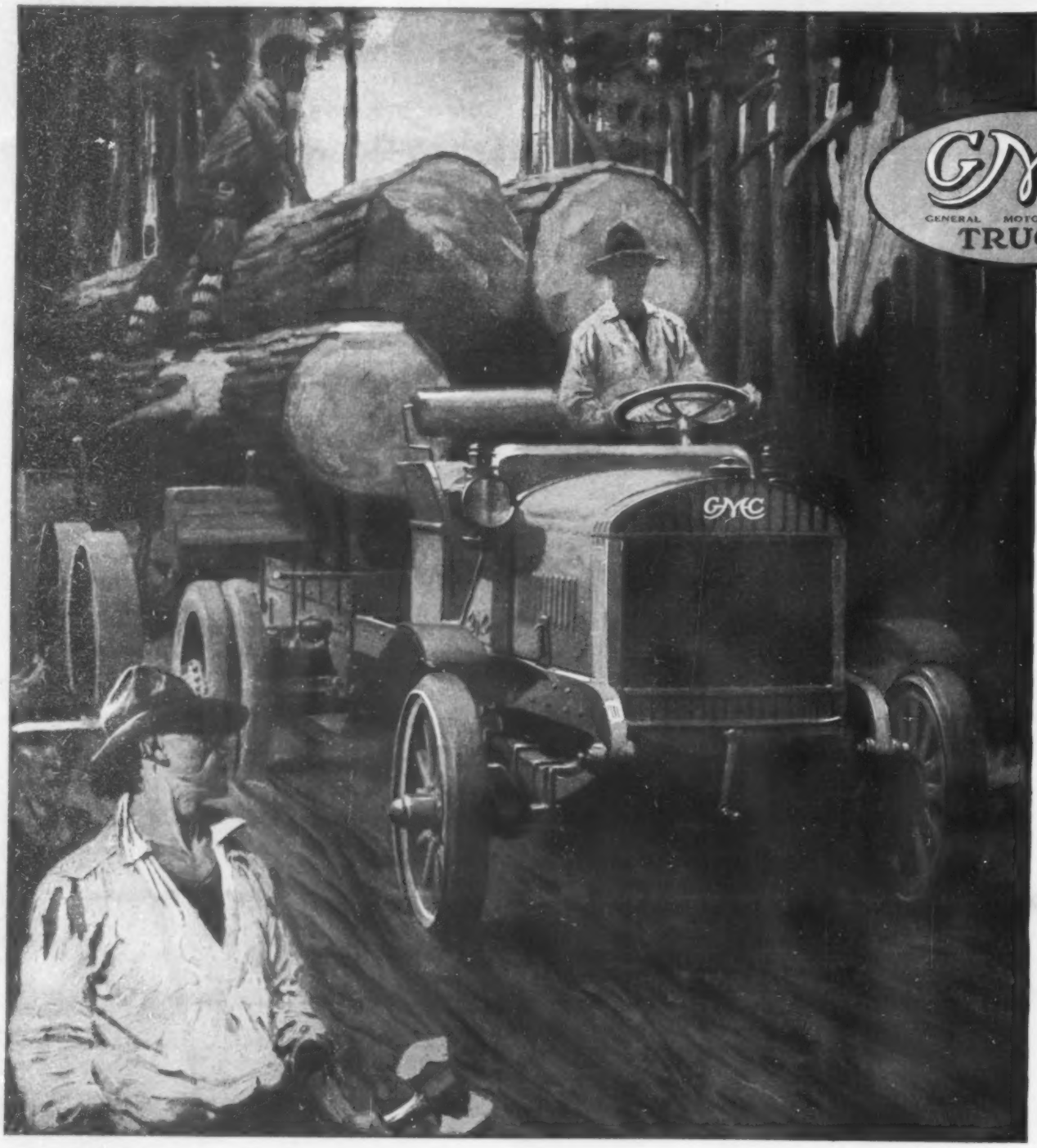

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